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PARLIAMENT OF TASMANIA.

REPORT OF THE SECRETARY OF MINES FOR 1890-91 :

INCLUDING INSPECTOR OF MINES' REPORT.

Presented to both Houses of Parliament by His Excellency's Command.

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REPORT OF THE SECRETARY OF MINES.

Office of Mines, Hobart, 31st July, 1891.

SIR,

I HAVE the honor to submit my Report upon the Mines Branch of the Lands and Works Department, for the year ending 30th June, 1891.

Appendices. Appended will be found Reports of the various Commissioners upon the state of the mining industry in the divisions under their charge; the Report of the Inspector of Mines; the Annual Report of the Geological Surveyor; the Report of the Mount Cameron Water-race Board; Reports by the Geological Surveyor upon the Spring Bay Coal, the Hydraulic Limestones at Maria Island, the Mount Zeehan and Mount Dundas Silver Lead Fields, the Beaconsfield Gold Fields, and the Tin-bearing Gravels of the Gladstone District, with Notes upon Hydraulic Elevators; Returns of the operations of the Diamond Drills, with tables showing the yields of Gold, Tin, and Coal; the number of persons engaged in mining; the number of Leases and area of land held for mining purposes; the net Revenue paid to the Treasury from Mines, with the amount of Dividend Tax paid by Mining Companies.

General remarks. At no previous period in the history of the Colony has the mining industry presented a more hopeful aspect than at present. The silver discoveries at Zeehan and Dundas, which are, undoubtedly, of vast extent and richness, have led to discoveries, not only of silver, but of gold and other metals and minerals in various parts of the Colony. Attention has been attracted to and capital invested in the development of the mineral wealth of Tasmania to an extent not likely to be dreamt of by the most sanguine, although, as will be seen later in this Report, the yields of metals and minerals during the past year, with the exception of coal, show a falling off. This must not be taken as any indication of a decadence in the mining industry, for the reasons for such falling off are explainable in every instance. The development of the silver deposits, situated as they are in wild mountainous trackless country, subject to an exceptionally heavy rainfall, is, necessarily, a matter requiring time; but, so far as the fields of Zeehan and Dundas are concerned, active preparation is being made for the near approaching completion of the railway, which will afford means of transporting machinery to the field and ore therefrom; and it is no idle prediction to assert that the immediate wealth of these two fields alone will go far to revolutionise the Colony at no distant date.

During the year discoveries of gold at the Ring River, some ten miles north east of Dundas, of silver at the Savage River, the Vale of Belvoir, the Dial Range, and at Mount Field West, all of considerable importance, have been made, whilst other discoveries, of present lesser importance, of gold, tin, and silver, have been reported in various localities. Some of the older established gold and tin fields are also affording satisfactory evidence of revival.

A most gratifying proof of confidence in the mineral wealth of the Colony is afforded by the large amount of foreign capital which is being invested in mining ventures, and in railways, harbour works, and other projects connected therewith.

Gold. The yield of gold for the year has been 20,000 ounces, as against 29,240 ounces for the previous year. This falling off is due to the suspension of operations at the principal mine at Beaconsfield during the erection of more extensive pumping appliances, and to no other cause. Some of the old established fields are giving promise of revival, notably Lefroy and Mathinna. At the former place the yield for the year has nearly doubled that for the preceding year, whilst at Mathinna steady development is taking place; the leading mine—the New Golden Gate—has yielded 7304 ounces of gold during the year, and, besides having added considerably to its plant, has been enabled to pay £9600 in dividends. Discoveries of some importance have been made at the Ring River, about ten miles from the Dundas silver-field, at the Savage River, and at other localities deposits of less present importance have been found.

Silver.

The Mount Zeehan field is steadily developing. Active operations are proceeding in all parts. The work of shaft-sinking, construction of tramways, and general preparation for the large output of ore which will assuredly take place upon the completion of the railway, is proceeding with vigour. The only mine which has exported ore to any great extent is the Silver Queen, which, during the last half-year has (at heavy cost for transit) exported 994 tons, yielding net returns of £18,570, and has been enabled to pay £8640 in dividends.

A population of some 2500 persons is already located at Zeehan. The town contains some fine buildings, and is assuming considerable proportions.

Dundas, owing to difficulties of transit, has, as yet, exported no quantity of ore. The development there has been very extensive. The early completion of the Zeehan-Dundas branch railway will enable the admittedly rich ore deposits of this locality to find their way to market in vast quantities. A town is rising up here also; and ere twelve months have passed, the towns of Zeehan and Dundas will be connected by settlement all along the route, and a very large population will be settled there. During the year new finds have been made, extending from Dundas northerly about ten miles to the Pieman River; north-easterly about ten miles to Mount Read; and south-easterly about a like distance to Mount Tyndall.

The total area of ground taken up for mining purposes at and around Zeehan and Dundas amounts to 87,000 acres.

Heazlewood and Whyte River.—These fields, hitherto retarded for want of a road, are developing steadily; and, with the completion of the road and the Godkin tramway, much progress will be made during the coming summer. A bulk test of some 27 tons of ore from the Godkin mine yielded 2763 ounces of silver, or an average of 102 ounces per ton..

Extensive finds have been made during the year, notably at the Savage and Whyte Rivers, at Waratah, at the Dial Range, at the Vale of Belvoir, at Mount Claude, at the Florentine: and, coming nearer Hobart, at Mount Field West and at the Dromedary, besides other localities.

The area of new ground taken up during the year for silver mining purposes is 81,851 acres.

Tin.

The yield for the year has been only 4783 tons, as against 5074 tons for the corresponding period in last year. This falling off is due mainly to the drawing off of large numbers of miners to the more attractive silverfields, but partly also to the fact that considerable areas of alluvial tin ground in the Eastern and North-eastern Divisions is worked out. Lode tin mining is just now attracting some attention. In the Eastern Division discoveries are reported which, if they come within measurable distance of their reputed wealth, will very shortly give highly satisfactory results.

Coal.

The output of coal for the year has been 51,593 tons, being an increase of 11,000 tons on the year. A considerable development has taken place in the Mersey District. The output from this locality during the year has been 5026 tons.

A large amount of prospecting for coal by means of diamond drills and otherwise has taken place at the Mersey, at Spring Bay, at Macquarie Plains, at Langloh, near Hamilton, and at the Henty, in close proximity to the Strahan-Zeehan Railway. The prospects are encouraging, but further time is required to prove results.

Iron.

A considerable deposit of iron ore is being developed with much energy, near the Blythe River. The quantity is undeniable, whilst the published analyses and tests are highly satisfactory.

Other metals and minerals.

There have not been any very important discoveries or developments of these during the year.

Evidences of activity.

During the year ending 1st July inst., 488 leases for 25,000 acres of land, have been issued, and 1830 applications, for 97,000 acres, are in process of being dealt with, besides a large number of grants of water rights and mining easements.

Areas leased and applied for.

The areas leased and applied for are as follows:—

	Acres.
For Gold	7700
Silver	119,000
Tin	32,000
Coal	13,000
Other minerals	4000
Total	175,700

against 70,795 acres on 30th June, 1890.

The revenue for the year for rents, application fees, licences, miners' rights, &c., amounted to £35,942, or an increase of £16,745 for the year; no account being here taken of large sums received by the Treasurer, but not credited to this Department, for stamp duties upon the registration of mining companies, transfers of mining leases, dividend tax, and other items incidental to mining. **The Revenue.**

During the year 164 mining companies have been registered, with an aggregate capital of £1,062,000. **Mining Companies.**

For departmental convenience the Colony is divided into Districts, as follows:—The Northern and Southern, comprising the country on the right and left banks of the River Tamar as far west as the River Forth, and on the east to the Scottsdale District, with such mineral country as there is in the southern portion of the Colony, and includes the gold-fields of Beaconsfield, Lefroy, and Lisle. The North-Eastern District comprises the whole of the north-eastern country, including several important tin-fields, with the gold-fields of Mount Victoria and Waterhouse. The Eastern District comprises the eastern portion of the Colony, and includes the tin-mining centres at Ben Lomond, Weldborough, and Gould's Country, with the extensive coal-bearing country around Fingal and Seymour, and the gold-fields at Mangana and Mathinna. The Western District embraces the wide area of country extending from the River Forth northwards, southwards, and westwards to the sea; it includes the celebrated tin-mines at Mount Bischoff, an extensive area of tin-bearing country at Heemskirk, the silver-fields at Mount Zeehan, Mount Dundas, and Heazlewood, the gold-field at the Linda, and other more or less important mining centres. **Division of the Colony.**

With the accession of work the staff at the Hobart office has somewhat increased, but the pressure is great, and increased assistance and office accommodation is required. At the Launceston branch an amalgamation of offices has involved some redistribution of the work. It is with very extreme regret that I have to record the untimely decease of the late Registrar, Mr. Percy Smith, an experienced and valued officer, who held and deserved the entire confidence of his superior officers and of the mining community. His loss to the department will be difficult to repair. **Departmental Staff.**

The report of this officer is annexed. It is noted with regret that the number of fatal accidents for the year is unusually large. **The Inspector of Mines.**

Valuable reports from this officer upon various portions of the Colony which he has visited during the year, are, in addition to his annual report, annexed hereto. **The Geological Surveyor.**

Two drills only are kept by the Government. Both have been working throughout the year. The results are annexed to this Report. **Diamond Drill.**

One company only is employed in expending the balance available upon this vote. Hitherto its operations have been unsuccessful, but of late it is reported that some gold-bearing leaders have been struck, which give hope that the expenditure will be justified by the results. **Deep-sinking Vote.**

The Report of the Board which has the management and control of this Race will be found annexed to this Report, and is of an encouraging character. **Mount Cameron Water-race.**

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

F. BELSTEAD, *Secretary of Mines.*

The Hon. the Minister of Lands and Works.

REPORTS OF COMMISSIONERS.

Mr. Commissioner Glover, in charge of this Division, reports:— **Northern and Southern Division.**

"In reviewing the mining industry in this division during the past twelve months, I have at length the satisfaction of reporting the existence of fair indications of the coming fulfilment of some, at any rate, of the hopes and expectations of the past.

"Hitherto the Tasmania Reef at Beaconsfield constituted the most important factor in the gold yield of the Colony; and when the richest levels were reached in the works on that reef, the constantly recurring obstruction from subterraneous water became insurmountable with the dresent appliances in use, and the miners being then driven out of the proper workings, the necessary consequence was that only a very limited amount of mining could be accomplished, and this in the all but worn-out upper levels; hence the serious apparent failure of the gold yield for many months past. The only effective remedy was the acquisition of sufficiently powerful machinery from England, the sinking of a new main shaft, and other appliances of equal magnitude. These requirements have been almost completed, though not yet ready for work; but within the past two months, by temporary improvement and expedients with regard to the existing appliances, the rich lower levels were occasionally reached and mining carried on, though for very short periods. These occasional opportunities for the due progressive working of the mines, intermittent and desultory as they were, have resulted in a remarkable increase of yield. This will be apparent on **Beaconsfield.**

reference to the yields of the first three quarters of the past twelve months—namely, 835 oz., 402 oz., 140 oz. respectively—whilst the quantity for the last quarter to the 30th June, owing to the occasional access gained to the lower levels, amounted to 5201 oz. The extraordinary apparent depression, therefore, in the yield of gold for the long previous period was not due, as supposed by many, to any failure of the gold resources of Beaconsfield, but to the fact that the progressive works on the Tasmania Reef were temporarily almost stopped pending the acquisition and erection of adequate machinery. The other undertakings at Beaconsfield are proceeding with more or less activity, whilst others, in which reefs have been struck, are suspended whilst further capital is being sought. The enterprise of exploring and proving the deep ground at the base of Cabbage Tree Hill by a Victorian syndicate is proceeding steadily, though some considerable time must elapse and much expenditure be incurred before any definite result can be realized; and a second Ballarat syndicate has recently initiated another similar enterprise on the same lead.

Lefroy. "At Lefroy the discovery of a payable claim on the line of reef known as the "Pinafore," which yielded, from a crushing of 477 tons of quartz, 638 ounces of gold, has given a great impulse to enterprise on that field, and several claims on the same line of reef have been taken up. Some indication of the value of the discovery may be afforded by the circumstance that the progressive yield of this mine for the last two quarters was 345 and 938 ounces respectively. It has also proved a stimulus to many prospectors who are now engaged in the search for new discoveries.

Denison and Golconda. "At the Denison and Golconda a remarkable revival of mining activity has recently taken place, in consequence of the discovery of reported rich reefs at each of those localities. Especially one at the former place is reported to be exceptionally rich, and foreign capital is engaged in its development, and machinery is being conveyed thither for that purpose. Under the stimulus thus given, there are also many persons engaged in prospecting throughout the locality.

Lisle. "At Lisle about forty men still find sufficient inducement to continue in the pursuit of gold-digging, and the estimated quantity obtained has been 1000 ounces for the year.

Middlesex. "At Middlesex Plains there is nothing worthy of mention, as no new developments have taken place. The want of water has, until very recently, prevented diggers from any work other than "stacking" wash stuff, ready for treatment when water shall be available.

Mersey District. "The quantity of coal raised at the Dulverton and Railton Collieries for the last quarter was 2650 tons, and the quantity for the whole twelve months was 6358 tons.

Norwich. The yield of the comparatively small coal-mining operation at Norwich was, for the last quarter, 500 tons.

Diamond Drills. "During the year, from 21st April to 31st October, 1890, No. 1 diamond drill was employed by a company in searching for an eastern extension of the Tasmania Reef at Beaconsfield. The operation was confined to one bore, which reached a depth of 979 feet, the last 517 feet being through solid limestone rock, when the work was abandoned. The cost of this bore was a small fraction over 14*s.* 9*d.* per foot. The same drill was again engaged from the 25th February last in boring for coal at Spring Bay, in which work it is still engaged, having accomplished, in three bores, 156 feet, 76 feet, and 424 feet respectively, and it is now proceeding with a fourth bore on the same locality. No. 2 drill has been employed in boring for coal at Macquarie Plains since 19th February last, and has finished one bore of 643 feet unsuccessfully; and it is now engaged in a second bore.

North-Eastern Division. Mr. Commissioner O'Reilly thus writes as to the Division under his charge:—

Gold.

"During the period since my last Annual Report, gold mining operations have been very limited,—principally confined to prospecting for remunerative quartz reefs; and a fair amount of legitimate work has been done in this way, with encouraging results.

Mount Victoria. "At Mount Victoria preliminary work is still being carried on by the Mount Victoria Gold Mining Company, in driving for the reef. This is the only claim that has been constantly mined at this place

"Very satisfactory results followed from a trial crushing of quartz made by the Strahan Company,—five tons of stone having yielded eight ounces of gold; but this encouraging result has not been followed up by the further development of the claim.

Waterhouse. "At Waterhouse the prospecting operations referred to in my last report have been successfully carried on; and I am informed that a new battery will shortly be erected by a Melbourne Company, on the Southern Cross claim.

"There has recently been a considerable extent of increased interest taken in the gold-bearing reefs in several localities in this district; and there is reason to hope that during the next twelve months a large amount of work will be done in prospecting and mining operations, and thus increased development made.

Silver.

Silver. "A discovery of a silver lode, which is reported as very promising, has been made by the Dorset Prospecting Association in the Waterhouse locality, and a reward claim applied for of 80 acres. This discovery was made by a prospector who gained some experience at the West Coast silver fields. I have no doubt, as practical miners who have some knowledge of silver lode formations return here from the West Coast, further discoveries will be made.

Tin.

Upper Cascade and Ringarooma. "There has been a considerable falling off during the year in the quantity of ore raised in the localities of the Upper Cascade River and Ringarooma, as also in the number of miners, European and Chinese, employed.

"Although there is a considerable extent of mineral-bearing lands, especially in the Mount Maurice locality, the deposits of ore are considered too poor to mine profitably at the present rates ruling for tin.

"I regret to find that no active steps have been taken during the above period to develop the tin lodes known to exist in some few of the claims at the Upper Cascade River; but I trust that during the coming summer months that energy will be displayed in this direction.

Branxholm. "The depression referred to in my last annual Report with regard to this locality still remains, although there are favourable prospects of its partial removal during the coming year. On an average 50 European and 70 Chinese miners have been employed, with an output of about 200 tons of tin ore. I am informed that the principal mine in this locality, the Arba, will in future be mined by European miners, and preparatory work has been here carried on for some time; active mining operations will be resumed in a short time. The prospects of this claim are considered very good. The adjoining claim of the Ormuz T. M. Co., situate in private property, I am also informed, appears promising as to producing satisfactory yields. A considerable extent of preliminary work has been done on this claim, and I understand that machinery will soon be erected for raising the wash.

"There are several small claims in this locality being mined with considerable vigour and enterprise, the yields being remunerative. The Ringarooma Valley T. M. Co. employ 24 European miners, and are carrying on extensive mining operations. The Argyle T. M. Co. have erected pumping machinery, and are with vigour prospecting the tin lode on their claim near Branxholm. The prospects are considered very good.

Brothers' Home and Main Creek. "At Brothers' Home three of the principal claims are now being mined, and employ a large number of European miners. The Briseis Tin Mining Co. have provided, at considerable expense, machinery for removing the overlay of deposit resting on the tin-bearing wash, and have removed a considerable quantity of material in this way, but as yet have not sufficiently advanced with the work to enable the tin ore to be raised. Sixty European miners are employed by this Company on this claim. The adjoining mine of the New Brothers' Home No. 1 Tin Mining Co. has not been mined for some time in consequence of the action at law taken in the Supreme Court by the former Company, which resulted in the Court granting an injunction restraining the latter Company from carrying on mining operations adjoining the boundary line between the two Companies' claims, in which place was found the richest deposit of tin on the latter Company's mine. The stoppage of works in this mine has caused much depression in business in the locality, as a large number of miners were usually employed. The Triangle and North Brothers' Home Tin Mining Co. have erected machinery for raising the wash-dirt in the usual manner, and will soon be in a position to produce an output of tin ore with very favourable prospects of success. There are several small claims being mined in the locality of Main Creek, the returns from which appear satisfactory.

Moorina. "There are not many claims being mined in the Moorina locality, beyond a few at Frome and Weld Rivers and O.K. Creek, in all of which the prospects are considered good, and the returns remunerative.

Bradshaw's Creek and Wyniford River. "At Bradshaw's Creek the Pioneer Tin Mining Co.'s Mine has been worked on tribute by a party of about 25 Chinese, and the quantity of tin ore raised, considering the scarcity of water in the dry season—73 tons—is very satisfactory. I am informed that this Company are about having constructed, at a cost of £1000, a water-race from the locality of the O.K. Creek to their mine, which, when completed, the additional supply of water will tend very largely to increase the output of tin from this claim. The returns of tin ore raised from the Argus Tin Mining Co.'s Claim continue good, as also from several claims in this locality, especially the Garibaldi Tin Mining Co.'s Mine, which is now held on tribute by a party of about 35 Chinese, 260 tons of ore having been raised by them during the past twelve months.

Mount Cameron. "There have been a considerable number of claims mined in the Mount Cameron locality during the past year, and, on the whole (considering the drawbacks incidental to those mines that cannot be supplied with the water from the Government Water-race or the Esk Tin Mining Company during the dry season), the returns are satisfactory. The above Company are now supplying water to claims in the immediate locality of the town of Gladstone that have hitherto remained unmined through the difficulty of obtaining a water supply. Although tin lodes of a promising character have for some time been known to exist, but little has been done towards prospecting them in a practical manner. Recently on the Mount Cameron Tin Mining Co.'s Claim tin-bearing lodes have been found, and it is to be hoped that this Company will put their usual enterprise into the matter, and have them properly prospected.

Mount Horror. "There are a few tin claims being mined in this locality by Chinese, who appear to be doing fairly well.

Mount Stronach, Scottsdale. "But little has been done here during the past year in the way of mining operations. A local company is now being formed at Scottsdale to mine a claim, which appears promising from the prospecting work already done on it.

Tin ore shipped. "The total output of tin ore from the North-Eastern District for the year ending 30th June, 1891, amounts to 1655 tons 1 cwt., as against 1921 tons 14 cwt. for the corresponding period of 1890, there being a decrease of 266 tons 13 cwt. This, so far, is the lowest output on record for several years, and I attribute the falling off, in a great measure, to the temporary stoppage of a few of the large claims that have hitherto produced large yields of tin ore, also, to a considerable amount of "dead" or preparatory work being done on others, and the investment of capital in the West Coast mines that hitherto was applied to this district.

Number of miners employed. "During the past year there were, on average, 262 European and 486 Chinese miners at the mines in this district. A number of European miners and prospectors have left for the West Coast silver fields, and a considerable number of Chinese miners have left for China and Victoria, having succeeded very well at the mines here, and have taken with them considerable sums of money.

General observations. "As the depression referred to in this report with regard to the state of tin mining in this district appears to me of a temporary character only, I see no grounds for departing from the favourable opinion I have hitherto expressed with regard to the progress and permaneney of this important industry for many years to come."

Eastern Division.

Mr. Commissioner Dawson reports:—

Tin mining.

"The yield of tin from this division has maintained its average during the year. The anticipated development by the St. Helen's Tin Mining Co. of an extensive area of tin-bearing ground, about six miles from St. Helen's, has not taken place. For some unexplained reason the Company have not so far carried out their water scheme by which alone the ground can be successfully worked; latterly, considerable stir has been produced owing to discoveries of some very promising tin lodes in the vicinity of the Blue Tier Junction. The successful working of the Anchor mine in that locality has given an impetus to prospecting, which, from present appearances, is likely to yield good results.

Gold mining.

"The scene of this industry is at Mangana and Mathinna. At the latter place, the New Golden Gate mine has yielded some 7000 ounces of gold during the year, has added very materially to its plant and workings, and its success has given a great impetus to the work of developing the adjacent mines on the field. The prospects of this field are hopeful in the extreme.

Silver.

"Some discoveries are reported as having lately been made in the Ben Lemond District, but I have as yet no authentic information upon the subject.

Coal.

"The collieries at Mount Nicholas and Cornwall have worked steadily on throughout the year. Their output is gradually increasing.

"The condition of the mining industry in this division is healthy."

North-Western Division.

Mr. Registrar O'Neill reports:—

"During the past half-year the mining industry in this Division has greatly improved, both as regards gold, silver, and tin, and there is every appearance of even greater developments, especially in gold and silver.

Silver.

"At the Godkin Silver Mine, Whyte River, extensive machinery is in course of erection,—in fact, at this date is about finished. This Company has completed three miles of tramway, and is engaged extending the same about six miles further, in the direction of Waratah. A bulk sample of 25 tons was sent away by this company, which gave a very satisfactory return.

"All the other mines in the same locality are in active operation, with every prospect of success.

"Near Waratah (North Valley) a very rich discovery was recently made, and here a track has been cut connecting this property with Waratah, and a tramway will be commenced without delay.

"At the Magnet Range and along the new road from Waratah to Heazlewood apparently rich discoveries have been made.

Gold.

"Extensive operations are going on in the locality of the Savage River, where a rich deposit is believed to exist, as good assays have been obtained from the formation that exists there.

"In alluvial mining very good results have been obtained by the few miners engaged in this work.

Tin.

"The Mount Bischoff Company is turning out about the usual yield, and the North Valley is pushing on with the erection of machinery.

"The Stanhope Tin Mine, which has been idle for some time, is again in work, having been taken in hand by a tributing company.

"There appears to be little doubt that this Division is coming forward rapidly, and business places are being erected in various localities, and population settling in the locality of the various mines."

Western Division.

Mr. Commissioner Fowell reports as follows:—

Zeehan and Dundas.

"The anticipations as to the progress of the District contained in my last yearly Report have been fully carried out by results. The population has increased to a very marked extent, and this is a sure sign of progress. Another feature I have noticed is that miners in employment on the field have brought down their wives and families. A large number of people have settled down in business, and are building substantial houses, with well-stocked shops, all which prove the confidence the present residents on the field have in its permanency.

"There cannot be direct development of the field until the railway is opened and machinery can be obtained. The present difficulties caused by cartage from Trial Harbour not only affects the mining industry, but very materially adds to the cost of everything at Zeehan.

"The rapid increase of population has caused a very large demand for residence areas, and every effort has been made to meet it. The surveyed town of Zeehan has not been settled upon, only one house as yet having been built upon the purchased allotments. The settlement has extended along the main road from the turn-off to the Silver Queen Prospecting Association to the Silver King mine. In view of its becoming a part of the future town, streets have been laid out, and permits have only been granted when the areas applied for have been properly fixed on the Surveyor's plan; this has been strictly carried out to avoid persons taking up areas where the land may be required for streets or public reserves.

"At Mount Dundas a township has been surveyed; the tramway now being constructed will run close to it. Its position is, I believe, the best obtainable in the neighbourhood, the greater part being high land, easy of drainage, and the surveyed available areas are nearly all already occupied by holders of residence licences.

"Prospecting was pushed on vigorously during the summer season; valuable discoveries have been made in the neighbourhood of Mount Tyndall, and also towards Mount Read. From Dundas sections have been applied for in a northerly direction to the Pieman River, and across it for a considerable distance, and there can be now no doubt that the Zeehan and Dundas field will be connected with the Whyte River and Heazlewood discoveries.

"Lately gold has been obtained in small creeks leading into the Ring River, a tributary of the Pieman. I have seen various samples; it looks much water-worn, and is generally found in the fissures and crevices at the bottoms of the creeks. These creeks are reported to take their rise near Mount Murchison, and when the weather allows it there can be no doubt that part of the District will be prospected.

"As regards the portion of the district about Mount Lyell, work for a time has been almost, if not quite, discontinued. The Mount Lyell Company are taking measures whereby their mine may be more thoroughly worked. Several alluvial claims are likely to be united and worked by a Company, and, consequently, this portion of the Western Mining District may soon be expected to take the position so long looked forward to. Mount Lyell.

"So far as the general work on the field has been carried out during the past year, I am of opinion that as much has been done as could reasonably be expected. The claims particularly worthy of notice are the Silver Queen, Silver King, Mount Zeehan (Tasmania) Silver and Lead Mining Company, Mount Zeehan, and Balstrups; these claims have worked steadily on.

"The mines at Dundas have also been vigorously prospected, and up to present date fully realise expectations. The permanency and future cannot now be doubtful. As before stated, the railway is urgently required for further development, and that may now be confidently looked forward to as completed at the close of the present year or early during the coming one.

"It is also self-evident that Strahan must be the port for the silver field, and also the whole district; therefore the deepening of the bar will be an imperative necessity, and the sooner decided measures are taken in the matter the greater will be the advantage to the district and the colony at large."

ANNUAL REPORT OF THE INSPECTOR OF MINES.

SIR,

I HAVE the honor to forward to you my Annual Report on the working of "The Regulation of Mines Act, 1881," for the year ending 30th June, 1891.

Mining Accidents.—Though the total number of accidents in mines has been greater than last year—27 persons being hurt, as against 15 for the year ending 30th June, 1890,—the number of serious cases has, fortunately, been comparatively small, the injuries received in 17 instances being only of a trifling nature, and causing but a few days' loss of work. Of the remaining 10 cases, 4 were attended with somewhat serious injuries, though none very dangerous or such as to maim the men permanently, and six were, unfortunately, fatal. Of the persons killed, two were Europeans and four Chinese, and of those injured, 20 were Europeans and one a Chinese.

The causes of accident were as follow:—

(1.) *Explosions of Dynamite and Gunpowder.*—Four accidents occurred from explosions, resulting in injuries to eight persons, three of whom were killed by one explosion. These three were members of a Chinese contract party engaged under their own head man in blasting a tail-race in the Weld claim, near Moorina. The nights being very frosty their dynamite, of which they kept an undue quantity in their hut, was found one morning to be frozen, and the head man proceeded to thaw it over an open fire in the but by a process which can only be described as grilling it. The man was an experienced miner and had worked with dynamite for some years at Lefroy. He and another were killed outright by the explosion, and a third man died the next day.

Two men were scorched and bruised by an explosion of dynamite in the Western mine, at Mount Zeehan. They were blasting the face of a drive, and had charged two breast holes and one bottom hole; they fired the bottom hole first, and immediately after its explosion returned to fire the other two, when one of these exploded as they neared the face, its fuse having been ignited by the first explosion. The men had nobody to blame but themselves, as they should not have charged the upper holes till after they had blown out the bottom one.

Two men were hurt in the Mount Victoria mine through attempting to bore deeper a portion of a hole in which a charge of dynamite had been previously exploded. There was a small piece of an unexploded cartridge in the hole, and one of the men pulled it out and then inserted a gad into the hole and struck it with a hammer; some nitro-glycerine must have oozed out from the old charge, for an explosion followed the blow. The practice of boring old holes deeper is expressly forbidden by law in Victoria, New Zealand, and elsewhere, and should be here also. The mining manager affirmed that he had often cautioned the men against boring in old holes, hence they had only themselves to blame.

The remaining accident was from an explosion of gunpowder in the Dulverton colliery. A man was charging a hole that was horizontal, or slightly inclined upwards, and was driving up the powder with a wad of paper taken from his pocket. After the explosion which ensued he remembered having wrapped some matches in this piece of paper. When struck by the tamping bar, which was of wood shod with copper, the matches must have ignited and fired the powder. The man's injuries were, luckily, only slight—the charge blowing out over his shoulder without throwing its burden.

It will be seen that all the accidents from explosives were due to carelessness or ignorance of the injured men.

(2.) *Falls of Earth.*—There were five accidents from this cause, resulting in the deaths of one European and one Chinese, serious injury to one European, and slight injuries to one European and one Chinese. The European miner who was killed was a tributer, and his own master in working his claim. While working at the foot of a high, steep face of gravel, a fall took place and killed him. His mate deposed at the inquest to having tried to persuade him not to trust himself under the face. The European who was seriously injured was working in the Dulverton colliery, and in his desire to get coal neglected to put in sufficient props under the roof, part of which fell upon him.

All the other accidents from falls of earth appear to have been pure misadventures, and not preventible by any foresight.

(3.) *Falls down Shafts, Winzes, or Passes.*—There were five accidents from this cause, one being fatal, the others of a slight nature. The fatal accident happened at Lefroy, in the new shaft being sunk by the New Pinafore Company ; one of the workmen was being drawn to surface by means of windlass and rope, when by some means he fell off and sustained injuries which proved fatal in a few hours. Only a fortnight later an exactly similar accident occurred in the shaft of the Dilston colliery. In this case the man, ascending with his foot in the bucket, is supposed to have been struck by the other bucket descending ; he was fortunate enough not to be severely injured. In neither of these cases were safety-straps used for staying the men to the rope as required by Section 11, Sub-section (16) of the Regulation of Mines Act, 1881 ; the mining managers of the two mines were therefore prosecuted for neglect to furnish such appliances. The Justices, taking into consideration the drawbacks to the use of cords or straps for staying men to the rope, and the sworn statements of numerous miners that they would not use them if provided, and that it was not expressly stated in the Act that special straps or cords were to be provided for staying men to the rope, and hence that it might be deemed sufficient if there were ropes about the mine which could be used by them if they should so desire, dismissed the case against the manager of the New Pinafore mine, upon which that against the manager of the Dilston colliery was withdrawn.

Of the other accidents from falls down shafts or winzes, one was due to a man missing his footing on a ladder-way, one to carelessly jumping down on to a platform near to the top of a winze and falling off it down the latter, and one to falling down a pass. None of these should have happened if ordinary care had been exercised by the injured men.

(4.) *Falls of material down Shafts.*—Two accidents from this cause resulted in slight injuries to three men. In every instance the men themselves were to blame for filling the bucket used in sinking too full, or for not steadying it sufficiently before it left the bottom of the shaft so as to prevent it swinging about as it was hauled up.

(5.) *Machinery in motion.*—Three men were injured, two rather seriously, by being caught in machinery. In these two cases the men were themselves in charge of the machinery, and were cleaning it while in motion. The other accident was a trivial one, but due to a mistake of an engine-driver, not of the person hurt.

(6.) *Other causes.*—By a fall of rotten timber while taking down some old trestle-work one man was slightly hurt. Another was injured by a splinter of a gad flying into his eye and injuring it so as to compel him to go to Melbourne for treatment. A third man received a serious scalp wound and blow on the head while running away from the face of a drive where an inrush of sand and water was taking place, by striking his head against a spreader which had been put in under the cap of one of the sets.

It is highly satisfactory to note that in very few of the above cases could any blame be fairly ascribed to the management of the mines. On the other hand it is not all satisfactory to see that almost every one of the accidents might have been prevented by the exercise of reasonable precautions by the workmen themselves.

Plans and Sections of Underground Workings.—The rapidly increasing number of mines with extensive underground workings has necessitated a large increase in the number of plans sent into this office, particularly as it is necessary, in order to ensure compliance with the Act as it now stands, that all mines likely to be large in future should be annually surveyed, mine-owners being only required by law to send plans of the workings made during the twelve months preceding the notice to furnish them. Hence, if a mine is allowed to go without being surveyed for some years there is no obligation upon the owners to furnish complete plans, and the obvious intention of the Act might be frustrated. The annual surveys entail a great deal of expense both to owners and the Government. It would be expedient in my opinion for the existing law to be amended so as to allow of the plans being furnished at longer intervals than one year, and to make it necessary for them always to show the complete workings of the mines, and not merely portions of them.

There has been such a demand for surveyors for the West Coast mineral lease surveys that it has been very difficult this year to get the plans of the mines sent in during January, as required by law, and in numerous cases extensions of time have had to be allowed for their production. Altogether, plans and sections of 27 mines have this year been received. They are all prepared by authorised surveyors, and in most instances have been well and faithfully made. Some, however, have had to be referred back to the surveyors for correction before being accepted.

Mines visited by Inspector.—Owing to press of other business, it has not been possible for me to make a regular round of inspection through all the mines of the Colony, and several districts could not be visited at all. The mines in the following districts have, however, been examined in the course of the year:—Beaconsfield, Brothers' Home, Moorina, Gladstone, Mount Zeehan, and Mount Dundas, and visits have been made to the New Pinafore, Dilston, and Dulverton mines on special occasions of accidents. The state of the mines as regards safety of the workmen and observance of the Regulation of Mines Act is generally satisfactory. Only one complaint as to insecurity of workings has been received from men working in the mines, the case being that of a mine at Mount Zeehan, where a shaft was being sunk without sufficient timbering. Instructions were at once given to properly secure the shaft, and were complied with immediately.

I have, &c.

A. MONTGOMERY, *Inspector of Mines.*

The Secretary of Mines, Hobart.

ANNUAL REPORT OF THE GEOLOGICAL SURVEYOR.

Geological Surveyor's Office,
Launceston, 20th July, 1891.

SIR,

I HAVE the honor to submit my Annual Report for the year ending 30th June, 1891.

During this period I have made examinations of the country in the vicinity of Spring Bay and Buckland with regard to the probability of finding coal there, of the north-western portion of Maria Island and its beds of hydraulic limestone, of the Mount Zeehan and Mount Dundas silver-lead fields, of the Beaconsfield District, in completion of the survey begun last year, and of the Gladstone District. I have had the honour to send you reports on all these. An Addendum to the Report on the Spring Bay coal field, giving further information as to the coal at the Back River or Prosser's Plains, has also been forwarded, and I append hereto a note of some facts that have reached me since, which affect certain particulars of the Report materially. Besides these reports, papers have been prepared for the Year Book of Australia and for the Tasmanian Official Record on the mineral resources of Tasmania, and for the Agent-General on the silver deposits of Tasmania.

Two new metallurgical processes which have come into use in neighbouring Colonies appear to be likely to be of great value—viz., the Molesworth Roasting Process and the Macarthur-Forrest Cyanide Process; and short descriptions of their principal features, as far as I have been able to ascertain them, are appended hereto.

Though the diamond drills are under the supervision of Mr. Commissioner Glover, the cores obtained have always been sent by him for my inspection; consequently I have prepared and sent herewith sections of the strata passed through in the various bores put down during the year. That of the East Tasmania bore is attached to my Beaconsfield Report already forwarded to you.

I have, &c.

A. MONTGOMERY, *M.A.*,
Geological Surveyor.

The Secretary of Mines, Hobart.

ADDENDUM NO. 2 TO REPORT ON COAL FOUND AT SPRING BAY.

Mr. R. Robinson, of Triabunna, who has taken very great interest in the prospecting for coal throughout the Spring Bay District, has, since my report was issued, written to me that I have been misinformed as to some of the old workings. This may very well be, as no written records appear to have been kept by my informants, who therefore spoke from memory only. There seems little possibility now of ascertaining which versions are most nearly correct, so I give Mr. Robinson's statement, as it differs considerably from those previously made by me to others.

Shaft C, known as Gurney's Shaft.—My informant as to the depth of this being 97 feet, and a drive having been put in for a distance of 50 feet, was to the best of my recollection Mr. Bresnahan, who worked himself in the mine. Mr. Robinson says:—"The facts are, that when the seam of coal (5 feet) was gone through in the shaft at a depth, as far as I can recollect, of 60 feet, a gullet was cut round the seam on the side of the shaft, and a block or section of seam was taken out, put into a box 5 feet long 18 inches square, and sent to Melbourne to show the seam to its full depth. . . . No drive was made in Gurney's shaft further than cutting round the seam to get a block out."

Shaft and Bore J.—With regard to this Mr. Robinson is a much better authority than anyone else, and speaks from a written record preserved by him. He gives the following section:—

	ft.	in.
Shaft.—Yellow clay	6	0
Yellow sandstone	10	0
White sandstone, soft and friable	12	0
Solid hard sandstone, dark grey colour, impregnated with fern fossils; alternate flat beds or laminations with fern fossils; largest depth without laminations 10 feet, beds horizontal	88	0
Soapstone, dark grey colour	8	0
Seam of coal, hard anthracite, and almost as near stone as possible	0	8
Soft soapstone, laminated	7	0
White very hard sandstone	14	0
Total depth of shaft	145	8
Bore.—Very hard basaltic sandstone (miners would call it bastard sandstone)	7	0
Dark sandstone, hard, free from fossils	30	0
Black clod	0	6
Dark soapstone	5	0
Black clod	0	6
Coal of a very hard character and inferior quality	1	4
Total depth of bore	44	4

Then very hard strata of a coarse character, quartzite, was reached, when water came freely and bore was abandoned. No 5 feet seam of coal was seen.

The borings with the diamond drill, now being carried out by Signor Bernacchi, will probably soon settle the question of the number of seams of coal that exist under Triabunna.

A. MONTGOMERY, *M.A.*, *Geological Surveyor.*

NOTES ON THE MOLESWORTH CALCINING PROCESS.

Mr. C. Ballard, Secretary of the Molesworth Ore-reduction Company, Limited, of Adelaide, has been good enough to send me copies of the specifications of the Molesworth Process Patents, and copies of newspapers describing the trials.

Mr. F. H. Molesworth is the inventor of the process, which is designed to greatly facilitate the roasting of metallic sulphides and arsenides. The calciner is a variety of the rotary type, and consists of a cast-iron cylinder wider at the end at which the ore is fed in than at the outlet end. It is rotated by suitable gearing outside, and runs on friction wheels so as to turn easily. Rows of small shelves are provided inside for raising the ore as the calciner revolves and showering it through the oxidising current of air. The cylinder is fixed so that the ore keeps constantly travelling downwards towards the outlet end, and, by altering the inclination and the number of revolutions, the time required to pass a charge through may be varied. So far, the description would answer for numerous revolving continuously-discharging roasting furnaces in common use. In these, however, the flames from the fireplace pass directly through the calciner, and the draught is always so great as to winnow out all the finest dust from the charge of ground ore, thus necessitating the use of long dust chambers. The new calciner is heated from the outside, and the draught through it need only be sufficient to supply the air necessary for combustion of the metallic sulphides. The roasting, it is said, need not be done at such a high heat as to injure the iron cylinder. A low temperature of roasting, which is, for many purposes, a great advantage, is therefore another point claimed in favour of the process. To economise fuel, and yet heat the cylinder as evenly as possible, the fireplace of the furnace used is built under the discharge end of the apparatus, where the greatest heat is required. The flames and hot air pass round this, and then are made to circulate round the remaining part of the cylinder by means of a spirally-arranged flue. The ore is ground to whatever fineness is deemed desirable, and fed continuously from a hopper into the wider end of the calciner. Up to this point there is still nothing very new about the arrangement, and if the only improvement consisted in heating the calciner from outside instead of sending the furnace gases through it, it would probably be found to be more expensive and less efficient than the common types. The novelty, which is the real heart of the invention, is the use of nitrogen peroxide gas to assist the oxygen of the air in burning off the sulphur and arsenic. This gas is a powerful oxidiser, giving off half of its contained oxygen very readily, and so becoming reduced to nitric oxide gas. This latter gas, in contact with air, at once combines with more oxygen from it, and is reconverted into nitric peroxide. This gas acts, therefore, as a carrier of oxygen from the air to the substances to be burned. Were it possible in practice to avoid loss of gas, it would be possible theoretically for a very small amount of nitrogen peroxide to work in the roaster for ever. The action of the gas as a carrier is well known and taken advantage of in the manufacture of sulphuric acid. The narrowing of the cylinder at the outlet end is said in the patent specification to be for the purpose of applying the gas there in its most concentrated form, just as it is delivered from the retorts. These are placed on top of the flues of the heating furnace, and contain crude nitrate of soda and sulphuric acid. The temperature is sufficiently high to break up the nitric acid formed by the reaction of these substances into water, nitric peroxide, and free oxygen. These are drawn from the retort into the calciner along with the necessary supply of air by means of a suction fan in the flue leading the products of combustion away from the cylinder. In order to recover the nitrogen oxides, and also to prevent the escape of the acid gases from the process generally, the products of combustion are drawn through water. As crude nitrate of soda

contains a good deal of chloride of sodium, a quantity of hydrochloric acid comes into the apparatus, as well as oxides of nitrogen, and, as the sulphur of the ore burns to sulphur dioxide gas, and the arsenic to arsenious oxide, the water through which the gases are drawn becomes highly charged with nitric, sulphuric, hydrochloric, and arsenic acids. According to the patent claims, this acid mixture is to be used to dissolve gold from the roasted ore when auriferous pyrites have been treated.

As far as the roasting is concerned, the process seems to make excellent use of a well-known chemical principle, and accordingly the results claimed to have been obtained are quite credible, but I cannot say the same of the alleged treatment of the gases after they leave the furnace. In the first place it is notoriously a difficult matter to arrest furnace gases by drawing them through water except by the use of costly and cumbrous coke or flint washing towers. Secondly, the acid obtained would be so impure as to be unfit for use in dissolving out gold. Moreover, it would be mostly sulphuric acid, formed by the oxidation by the nitrous gases of the sulphur dioxide from the combustion of the ore. Even if it were nitro-hydrochloric acid, however, it could not be used for the purpose of dissolving out the gold from roasted pyrites, for *aqua regia* is not like chlorine, able to exercise a selective action on the gold without attacking the oxide of iron, but would dissolve the latter and expend itself in doing so. The waste acid might possibly by boiling be made to give off chlorine, which could be used for chlorination, but I am afraid that the claims made for this part of the process have not been practically worked out. Even on theoretical grounds they are open to many objections.

The claims in the patents as to the use of the waste products of combustion do not affect the main issue—the success of the roasting. It is clear, however, that the construction of the furnace renders it possible to make sulphuric acid from the waste gases with a success shared by none of the calciners where the products of combustion of the fuel are mixed up with those of the ore, and a saving of cost might be effected by doing so. The rapidity of the roasting, implying a very copious evolution of fumes of sulphur dioxide, would be very favourable for the supply of this gas to sulphuric acid chambers in a sufficiently undiluted condition.

The process has been introduced at the New Alma and Victoria gold mine, Wankaringa, South Australia, and is reported to be working very well. The newspaper reports are very favourable as to the great rapidity, cheapness, and thoroughness of the roasting, and private information given to me confirms them. Very little nitrate of soda is required, and very little fuel for the heating furnace, the combustion of the sulphides itself supplying the greater part of the heat required. Though still hardly past the experimental stage, the results of Molesworth's treatment appear to be so good that the process deserves the attention of all concerned in the roasting of sulphide ores. Probably experience will result in numerous changes in the details of the plant, and very likely in its entire remodelling: such changes are a part of the evolution of every new process. Should the use of the oxides of nitrogen come up to the claims made for them in assisting oxidation, the new treatment will mark an important advance in one of the most important, universal, and expensive processes of metallurgy.

A. MONTGOMERY, *Geological Surveyor.*

THE MACARTHUR-FORREST CYANIDE PROCESS FOR THE LIXIVIATION OF GOLD AND SILVER ORES.

This process has been introduced by the Cassel Company at Karangahake, Auckland, New Zealand, and as the results obtained have been very good on an ore that has hitherto defied successful treatment by amalgamation, it appears likely to be a commercial success, and worth the attention of mining men. The ore treated was from the Crown mine at Karangahake, which consists of quartz charged with extremely fine metallic gold and sulphide and selenide of silver, with, occasionally, chloride of silver as well. From the difference between the amount of gold visible on the most careful grinding and washing or that can be extracted by amalgamation, and that obtained by assay, there is reason to believe that much of the gold is not in a free state, but exists in combination with the sulphur and selenium present. The ordinary battery treatment is quite a failure with this ore, extracting only from about one-fifth to one-third of the gold value. Amalgamation in pans succeeds much better, but is not altogether satisfactory either. The ore is much too silicious for smelting, and the chlorination treatment requires it to be roasted before it can deal with it, and then is not very successful after all. It is, therefore, a very difficult ore to deal with, and the cyanide process in successfully treating it has scored a victory over many competitors.

The result of a bulk test of a parcel of 263 tons 7 cwts. treated is given in the *Auckland Weekly News* of 14th March, 1891, as follows:—

263 tons 7 cwts. contained, by assay, gold, 425 ounces; silver, 940 ounces.
Recovered and sold to the Bank, gold, 384 ounces; silver, 664 ounces.
Percentage of recovery, gold, 90½ per cent.; silver, 70½ per cent.

The cost of treatment is stated to have been 6*s.* 6*d.* per ton for drying and grinding the ore, and 13*s.* 6*d.* a ton for the lixiviation treatment. It will be seen that the extraction was very successful, the gold left in the tailings being only at the rate of 3 dwt. 3 grs. to the ton, and silver a little over an ounce to the ton.

The process depends on the fact that a weak solution of cyanide of potassium will dissolve gold, silver, and most compounds of silver very freely. A weak solution acts better than a strong one, and hence solutions containing only from ¼ to 1 per cent of cyanide are employed. No roasting is required, it being claimed for the process that it will extract both gold and silver from metallic sulphides without roasting. I am not aware, however, if this has been proved on a working scale. The ore is ground dry in Lamberton Mills, and put into wooden leaching vats furnished with false bottoms arranged for filtering, as in all other leaching processes. The quantity of solution necessary is about half the weight of the charge of ore, so that from 3 to 8 lbs. of cyanide are used for every ton. It is made to take about 36 hours to pass through

the ore-bed on the filters, and then runs into a series of wooden precipitating boxes filled with coarse granulated zinc. The gold and silver are precipitated on the zinc. The solution, after passing through these boxes, is assayed to ascertain its loss of strength, and made up to the original condition by the addition of a little more cyanide, and then may be used again. The gold and silver are recovered from the zinc by putting the contents of the precipitating boxes on a sieve and shaking this well in a vat of water. The loose precipitate is thus washed off and the zinc is returned to the boxes again. The muddy sediment of gold and silver is allowed to settle thoroughly, collected, washed with diluted sulphuric acid to remove any zinc left in it, washed well with hot water, filtered through calico filters, dried, and melted into fine bullion.

Part of the above description is taken from the annual volume for 1890 of "Reports on the Mining Industry in New Zealand," wherein Mr. H. A. Gordon gives a fuller description, illustrated by drawings. The following table of results obtained in the preliminary trials of the process at Karangahake is abridged from his report. Each of the tests was made on one ton of ore; consequently, they are working tests, not mere laboratory ones.

Assay Value of Ore per Ton.		*Extracted per Ton.*		*Percentage Extracted.*		*Percentage of Potassium Cyanide used on Ore treated.*
Gold.	Silver.	Gold.	Silver.	Gold.	Silver.	
oz. dwt. grs.	oz. dwt. grs.	oz. dwt. grs.	oz. dwt. grs.	Per cent.	Per cent.	
0 19 4	10 1 17	0 16 14	7 2 0	86·5	70·4	0·50
0 19 14	10 1 17	0 17 23	7 9 1	91·7	73·8	0·50
1 12 16	14 14 0	1 11 1	11 7 0	95·0	77·2	0·50
1 12 16	17 12 0	1 7 9	11 9 3	83·9	62·2	0·40
1 12 16	16 6 16	1 6 4	9 6 1	80·1	56·9	0·25
1 17 13	1 17 13	1 14 7	1 4 12	91·2	65·1	0·50
1 17 13	1 17 13	1 12 16	1 2 21	87·1	60·6	0·50
2 2 4	2 4 2	1 19 18	1 12 16	94·2	74·3	0·25
2 2 11	2 4 2	2 0 20	1 1 6	96·0	47·7	0·25
0 11 10	3 11 20	0 9 10	1 19 4	82·4	54·4	0·25
1 12 16	5 14 8	1 7 19	4 3 8	85·0	72·8	0·25
1 19 4	6 4 3	1 15 22	4 18 0	91·8	79·0	0·40

A. MONTGOMERY, *Geological Surveyor.*

REPORT OF THE MOUNT CAMERON WATER-RACE BOARD TO 30TH JUNE, 1891.

11th August, 1891.

SIR,

This Board has the honor to report as follows.

The Board was constituted by Act of Parliament, 51 Vict. No. 28, on the 20th December, 1887, and consists of the Secretary of Mines, the Commissioner of Mines for the District, the Inspector of Mines, and two members annually appointed by the Governor in Council. It commenced its duties on the 9th February, 1888, and assumed control of twelve miles of main race and nine miles of branches, which, under the authority of the Act quoted, had been purchased by the Government at a cost of £4750.

On the 21st of August last the Board received into its charge the whole work, consisting of 34 miles of main race and 9 miles of branches (including the original portion above referred to), which had been constructed and repaired by the Government at a total cost of £31,460 7*s.* 3*d.*, including purchase of the old portion of the race.

The receipts during this period, necessarily curtailed by stoppages for repairs and the limited supply of water obtainable, and of ground commanded by the old race, amounted to £687 13*s.* 11*d.*, whilst the cost of maintenance and management amounted to £631 14*s.* 5*d.*

During this period there have been 2330 heads of water sold. Receipts have been £1751 5*s.* 1*d.*, and the cost of maintenance and management has been £1087 9*s.*

The total sum paid to Sinking Fund to date has been £719 5*s.* 7*d.*, being ¾ per cent. upon the whole cost; but, at the present rate of receipt and expenditure, the net proceeds for the year 1891 will be 2½ per cent. upon the cost of purchase and construction.

The number of claims supplied since the race has been in full work has averaged, weekly, 10. These, which employ a considerable number of miners and yield a fair quantity of tin ore, could not have been worked but for the construction of this race. Other claims are in course of being opened.

The race has a carrying capacity of 50 Tasmanian heads, discharging 450,000 gallons per hour. The supply of water at the intake is more than sufficient to meet the present demand.

This is regulated according to the price of tin; but, with tin ranging from £80 to £100 per ton, the charge per head per week of six days of eight hours each has been 15*s.* per head for day water and 13*s.* 4*d.* per head for night water; prospecting water is granted at the rate of 10*s.* per head.

The Board employs a manager and four watermen and channel-keepers, whose duties consist in distributing the water and keeping the channel in order throughout its whole length.

In view of the fact that the quantity of water available is larger than the demand, and that a considerable area of ground is situate upon the western or Gladstone side of the Ringarooma River, which could be profitably worked by an extension of the race for a distance of about 4½ miles, at a cost of not exceeding £4000, a survey has been made, and a proposal will be submitted to Parliament to sanction the work, which, the Board is led to believe, will be of great benefit to the profitable working of the Race and to the community.

We have the honor to be,
Sir,
Your obedient Servants,

F. BELSTEAD, *Chairman.*
JOHN SIMPSON,
A. MONTGOMERY,
S. HAWKES,
C. O'REILLY,
} *Members of the Board.*

The Honorable the Minister of Lands and Works.

REPORT ON THE PROPOSAL TO BORE FOR COAL IN THE TOWNSHIP OF TRIABUNNA, SPRING BAY, AND ITS NEIGHBOURHOOD.

Geological Surveyor's Office, Launceston, 2nd August, 1890.

SIR,

I HAVE the honor to report that, in accordance with your instructions of the 8th July, I went to Spring Bay on the 15th ult., and put myself in communication with the Warden of the Municipality, Mr. Lester. I found that it was desired that I should report on the advisability of having a series of borings made by means of the diamond drill, to ascertain if payable seams of coal exist in the district, and on the the sites for such borings if undertaken. An examination of three different localities in this connection was requested,—namely, the township of Triabunna and its immediate vicinity, the Ravensdale Estate near Little Swanport, and Prosser's Plains on the Back River, some four miles west of Orford.

Triabunna and its vicinity.—I attach a map of the township of Triabunna and the country immediately surrounding it for the purpose of explaining this report. The township is laid out at the head of Spring Bay on a large alluvial flat, bounded towards the north and north-west by high hills of greenstone, and rising towards the south and south-east into low hills of sandstone. At Orford the greenstone ranges sweep round and come out on the coast line at the mouth of the Prosser's River, but between Orford and Spring Bay the country may be said to be all sandstone, with the exception of a mass of greenstone at Meredith Point. On the eastern side of Spring Bay the sandstone country predominates, reaching through to Oakhampton. The high spur running southward to terminate in Cape Bourgainville is, however, greenstone, and a great mass of this rock also reaches from Point Horne Look-out nearly to the Oakhampton quarries. Most likely there are many other intrusions of greenstone in the low range separating Spring Bay from Oakhampton Bay. Three dykes of this rock penetrate the sandstones at Dusky Bight, the Oysterman's Station, and to the north and south of these the sandstones are hardened, jointed, and baked-looking, as if they had been subjected to the action of great heat. The argillaceous nature of the sandstones on the beach allows them to show the effects of heat more than the white quartzose freestones overlying them. Whether the main masses of greenstone have been intruded through the sandstones or are of older date I have seen no evidence in the district to pronounce with any certainty, but in either case the result is the same as far as coal seams are concerned, the greenstone must cut them off. If the greenstones are of later formation than the coal measures, it is possible that they may form cappings over the latter in places, but I fear that much hope cannot be founded on this possibility in the district now in question, appearances being much more in favour of the belief that there have been no large overflows from the dykes. We may, therefore, regard the greenstones as forming the boundaries of the coal formation. It is a very difficult matter to make out the amount and direction of dip of the strata in this locality, owing to the sandstones which show in all the available sections being very much "false-bedded." As the result of a large number of observations, I came to the conclusion that there is on the whole a very gentle northerly dip of from one to two degrees, but that there are gentle undulations which alter the direction and amount of the dip very considerably. Faults breaking the strata are also probably present. Selwyn, in his report on this district, mentions a fault showing at the head of the estuary. I was not able to find the spot, probably owing to the creek being somewhat high, but the differences in level of the seams of coal struck on the east and west sides of the estuary of themselves point to the existence of such a fault. On the beach at the east end of Vicary street there is a bed of shaly clay striking N. 47° W., and dipping to the N. E. at the high angle of 52°, which indicates the proximity of another fault, the sandstones immediately to the southward being nearly horizontal.

There are two very distinct sorts of sandstone found in the area under consideration, one very quartzose, sharp to the touch, white or yellow freestone, the other composed chiefly of fragments of a felspathic rock now altered to clay, and containing sometimes very little, sometimes a good deal, of quartz sand. This is generally of a greenish grey, sometimes yellowish colour, and frequently contains fragments

of carbonaceous matter. Some of the beds contain mica, occasionally in considerable quantity. The felspathic sandstone lies immediately over the principal coal seam in all the shafts sunk to it on both sides of the estuary. It is seen on the beach all around the head of the estuary. From Patten Point southward along the eastern shore of Spring Bay to opposite Observatory Point a bed of felspathic sandstone is found similar in most respects to that just mentioned. It is overlaid by white freestone, which, from being 15 to 20 feet above high water mark opposite Observatory Point, dips gently down until north of Patten Point it altogether conceals the felspathic rock beneath. At Patten Point there is an outcrop of micaceous, black carbonaceous shale, and along the beach to the northward I found numerous fragments of hard brick red shales containing impressions of leaves of one of the typical fossil ferns of our upper coal measures. As I could not find any of this shale *in situ* above high-water mark, it seems likely that it lies lower down, perhaps under the felspathic sandstone. From its appearance, however, I should judge that the intrusive greenstone cannot be far from it, as it appears to have been hardened and altered by heat. It seems probable that the two beds of felspathic sandstone mentioned are separated by a thick bed of white freestone, and borings through the first felspathic bed, after passing through the known seam of coal underlying it, should be carried down through the freestone to try for a lower bed of coal in the second felspathic stratum.

A good deal of work has been done already to test the coal in this neighbourhood. On the map I have marked the positions of the various workings as nearly as I could ascertain them. It is much to be regretted, however, that reliable information as to what has been done in the past is now very difficult or impossible to obtain. Even when Mr. Selwyn reported on the field in 1855, he was unable to get exact information as to much that had been done. As his report is now almost unobtainable, I attach a copy of his plan and sections, and of the part of his report relating to Spring Bay. On my plan the letters A, B, C, and D refer to the shafts and bores denoted by the same letters on Mr. Selwyn's plan, except that C is now what is known as Gurney's Shaft, the shaft having been sunk on the previous bore. E on the plan is the site of another bore, pointed out to me by Mr. Bresnahan, but about which I could get no information whatever. F, G, and H are shafts sunk since Mr. Selwyn's report, about 1873, on the township, and J is a shaft sunk in 1875. K is the place where I think it would be advisable to bore with the diamond drill. In the shaft C, I was informed a seam of coal 4 inches thick was passed through at a depth of about 45 to 50 feet, and at 97 feet a seam 5½ feet thick was encountered. A drive was put in on this for 50 feet, but the coal proved useless. It has been suggested, with a great deal of probability, that the intrusion of the greenstone ridge to the north-east of the shaft may have been the cause of the impregnation of the coal with the large amount of mineral matter it contains. I was not able to get any of the coal to test this supposition in any way. This seam appears to be from 50 to 52 feet below high-water mark at points B and C. The stones round C show that the stratum of felspathic sandstone met with in shafts H and J here also immediately overlaid the coal, thus establishing the identity of the seams, and showing that there must be a downthrow on the eastern side of the fault. Shaft D, as Selwyn observes, is south of the line of outcrop of the coal, which must here dip to the northward more than two degrees, otherwise it would have been cut in the shaft. Shallow borings in the flat between C and D would probably soon strike the outcrop of the seam. I have not been able to find if any coal was got in the shaft F, but from both G and F coal was raised, and I was told that a shipment of 50 or 60 tons had been sent to Melbourne, but my informant could give me no information about its quality or the price it brought. From G a drive was made towards the Roman Catholic Chapel, or about N. 55° W., but whether it was driven level, on the dip, or to the rise, I could not find out. If level, its direction gives us the dip of the seam as about N. 35° E., which agrees fairly well with some other observations. It is to be presumed, from the fact of the abandonment of the mines, that the coal was not of good quality. None of it is now obtainable. At J a shaft was sunk for 155 feet, passing through felspathic sandstone full of carbonaceous matter, and with occasional thin beds of shale and of carbonaceous matter full of iron pyrites. From the bottom of the shaft a bore was put down for a further distance of 80 feet, which cut a seam of coal 5 feet thick at 205 feet, and then passed through several feet of fire-clay. Nothing further was done. It is clear, therefore, that the greater part of the western portion of the township of Triabunna is on coal, though probably much of it is of poor quality. Some 20 or 30 chains below the junction of Brady's and M'Laine's Creeks, the white, gritty sandstone crops out in the bank of the latter, lying nearly horizontal, and similar sandstone is seen in the flat to the west and south of it also. The coal-bearing area at present known may be said to lie between a line drawn N.W. from shaft F and the greenstone hills to the north of the township.

As the residents are anxious to set the question of the existence of workable coal at rest, I would recommend that they bore at K with the diamond drill. This is about the centre of the known coal area. The 5-foot seam ought to be struck at about 120 to 130 feet, and the bore should then be carried down to 700 or 800 feet to try for lower seams which may or may not exist. It is true that the shaft D shows no coal for a depth of 200 feet below the known 5-foot seam, but the beds of carbonaceous shale and felspathic sandstone found on the eastern side of Spring Bay do not appear to have been reached in it. These appear to underlie the white sandstones met with in the shaft, and may dip to the north-east more rapidly than their apparent north-westerly dip along the shore would indicate. As mentioned above, a bed of fossiliferous shale seems to exist somewhere in connection with the felspathic sandstone near Patten Point, which, with the carbonaceous shales, would indicate that it is by no means below the horizon at which coal might be expected. The large amount of false bedding of the sandstones may be taken to indicate that they were laid down in shallow water, consequently slight changes in the level of the shore might have led to the alternate formation of beds of sandstone and coal. The littoral character of the sandstones in this part of the country is further shown by the occurrence in Crabtree's Quarry, near Orford, of a bed of coarse gravel lying in a depression hollowed out of the previously existing sands. In this quarry it was reported that a bed of black shale was struck below the sandstones; but, if so, it is now quite covered over again. It is only by boring that the existence of lower beds of coal can be demonstrated or disproved; and, looking to the magnitude of the gain to the colony and to the district, should good coal be found near to such a splendid harbour as Spring Bay, I certainly think a bore should be put down. That there is a great risk of failure to find any coal of value is indubitable; but, on the other hand, the reward of success is a

great one. If the bore at K were carried down, say, to 800 feet, it would almost certainly yield us sufficient information to judge of the advisability of boring in other places in the district. To test the ground thoroughly, at least three bores are required: one in the middle of the large flat to the west of the township, and another inland to the east from Patten Point about 20 chains, in addition to the one at K. The boring should not prove very expensive. The strata are probably similar to those passed through by the diamond drill at Seymour, where the cost was 7*s.* 8½*d.* a foot. This might be fairly taken as a probable estimate of the cost of boring at Triabunna also.

Ravensdale Estate.—No coal of any sort has yet been found in this locality, but there is a very considerable extent of the coal measure sandstones, and there is therefore a possibility of finding coal by boring. On the road from Triabunna to Little Swanport greenstone is the prevailing rock passed over, though there are occasional patches of sandstones. The relation of these to the greenstone seems to me to favour the theory that the latter rock is of more recent formation than the sandstones, and intruded through them. Occasional dykes of greenstone may be seen clearly penetrating the sandstones, and I could see no reason to suppose that these dykes were of later origin than the main greenstone masses.

Between Triabunna and Grindstone Bay, and from Grindstone Bay north to Little Swanport the country is said to be all sandstone, so that if coal were found in it there would be a large field. Prospecting by borings is therefore well worth trying.

The Ravensdale estate contains a large extent of sandstone country. A large mass of greenstone comes into the southward from Mr. Salier's residence, and this rock also cuts off the sandstone to the south-west in Mr. Chaffey's property. The sandstones seen in the Ravensdale Rivulet are yellowish brown quartzose freestones, more highly inclined than those around Triabunna. No fossils were seen in them. In the creek some 30 chains above the shepherd's hut, beds of shale dipping east 4° to 5° are found. These underlie the sandstones found lower down the creek. I did not find any fossils in these either, and their position in the coal measures is therefore doubtful. Interstratified with the shales a thin bed of greenish felspathic sandstone similar to that overlying the Triabunna coal was noticed. Lower down the creek the sandstones dip more steeply, angles of 21° and 25° being observed, and at the crossing of the creek to the shepherd's hut and lower down it they again appear to be flatter, the angle of dip being from 7° to 3° easterly. As the section of the creek exposes a great thickness of sandstone beds without coal, I think that the best place to bore would be south of Shepherd's hut, where the drill would soon reach the unseen strata lying beneath the shales above-mentioned. A bore about 5 chains up the creek from the hut would be well situated.

Prosser's Plains, Back River.—This appears to be the most promising place of the three visited for finding payable coal, as the existence of a useful seam is known, and what has to be ascertained by boring is its extent and depth below the surface. The coal crops out in the Back River in Section 1682. The river being in flood at the time of my visit, the outcrop was not visible. Mr. Selwyn reported in 1855 on this coal as follows:—"At Prosser's Plains, in the Back River, a branch of Prosser's River, and about five miles from the residence of T. Cruttenden, Esq., two seams of coal occur, together about four feet thick, dipping (S. 15° W.) to (W. 20° S.) from 35° to 50°, and passing under a flat of about 2000 acres. These coals are bituminous, though not of first-rate quality. They ignite freely, and burn with a bright flame, but are of rather slaty structure, and contain a large percentage of earthy and incombustible matter. On three sides of the flat the carboniferous beds are cut off by high ridges of massive greenstone; but on the fourth side, towards the plain and in the direction of the dip, no eruptive rocks occur. In this direction the above seams of coal, and perhaps others, might be found at no great depth, over a considerable area. The distance, eight or ten miles, from the nearest shipping-place in Prosser's Bay, and the great expense attendant on the construction of the necessary road, appears the chief difficulty in the way of their being worked to advantage. The greater part of the ground is, I believe, the property of the Crown. The very high angle at which the seams are dipping where exposed in the Back River is probably only local; and they would most likely be found to flatten at a short distance on the dip, in conformity with the overlying sandstones to the south west."

I have very little to add to Mr. Selwyn's lucid description. The whole of the flat, from the outcrop of the coal down to the Prosser's River on the course of the Back River, is sandstone,—the greenstone rising abruptly on the east side of the latter stream. To the south west from the outcrop there is sandstone for a long distance, and this sort of country extends through to the back of Buckland. If coal lies under all of this sandstone, the field will be of great importance. Some years ago a shaft was sunk in the flat to the south of the coal outcrop about half-a-mile, but I could get no information as to its depth. It was abandoned before reaching the coal. The rock passed through was a somewhat felspathic sandstone, but containing more quartz sand than the felspathic sandstone over the coal at Triabunna. The same rock is seen in the side of the Back River, near the outcrop. Another shaft was sunk close to the outcrop many years ago, and coal was taken from it. I collected a few of the fragments strewed about the surface, and sent them for analysis to the Government Analyst. He reports thus:—

"The sample of coal from Buckland forwarded by the Government Geologist has been examined, and the following results obtained:—

	Per cent.
Fixed Carbon	73·6
Matter volatile at red heat	15·1
Sulphur	0·7
Mineral matter (ash)	8·0
Moisture lost at 212° F	2·6
	100·0

The coal does not coke. A workable seam of this quality would be of great value."

Local reports have always agreed in describing this coal to me as caking when fired. Possibly the weathered fragments analysed have lost this property. The analysis cannot be looked upon as fairly representing the bulk of the seam, as I did not pick up any of the fragments of black shale accompanying those of coal, though doubtless both came from the seam. It rather represents, probably, the purer bands of coal in the seam.

I have no hesitation in saying that boring should undoubtedly be done in this locality. The extent of the measures, and the size and quality of the seam, give every hope that payable coal will be found. For the first bore I should recommend a site about 10 or 15 chains W.S.W. from the outcrop. The unfinished shaft above mentioned would be a good site for a second bore.

The distance from the outcrop to deep water in Spring Bay is in a direct line about seven miles. I do not think that there would be any unusual engineering difficulty in getting a tramway to the harbour in about ten miles of distance. This would be no great matter if the coal was of good extent and quality.

Parishes of Hodgson and Page.—A glance at the county map shows the Parishes of Hodgson and Page to be still almost entirely Crown lands; I was informed that these lands were barren sandstone country, not fit for agricultural and pastoral purposes, and consequently not taken up. If the borings at the Back River and Triabunna should find good coal, there will be good reason to hope that it also exists under these barren lands. A geological examination of these should be made, and, if required, bores should be executed to test for coal.

In concluding this Report, I have to acknowledge many courtesies and much information from Mr. Lester, the Warden of Spring Bay, Mr. J. J. M'Clusky, Messrs. Salmon, Salier, Pitt, Mace, Stewart, and others, who did all they could to show me the District and to explain what had been done.

I have, &c.

A. MONTGOMERY, *M.A.*, *Geological Surveyor.*

The Secretary of Mines, Hobart.

COPY of Portion of Mr. A. R. C. Selwyn's Report upon some of the Coal Seams of Van Diemen's Land, 1855.

"*Spring Bay and the Township of Triabunna.*—The vertical section, Pl. II., Figs. 1, 2, 3, 4, are drawn from data furnished by Mr. Vicary.

The works are all abandoned for the present, and the shafts full of water. I was, therefore, unable to examine any of them.

As I had no map of the locality, the plan is merely a sketch of the surface, in which I have attempted to show the position of the different workings, and the general relations of the beds as seen on the surface. The shaft marked D was the first work executed, and was sunk with the intention of cutting the 3½ foot seam of coal, which is seen cropping below high-water mark on the west bank of the estuary, and which, but for the existence of the fault A.B., of which the parties do not seem to have been aware, would have been successful. Owing to this circumstance, however, they sank and bored 200 feet in beds immediately underneath the crop of the coal, and which are exposed to view on the surface to the south along the shores of the estuary,—thus wasting both time and money.

In the several bores and shafts A. B. C. D., a thickness of nearly 400 feet of coal measures has been proved, in which only one seam of coal of a workable thickness exists.

This seam could, however, I think, be worked over an area of at least 300 acres: this, taking the seam at 3 feet, and the cubic foot of coal at 56 lbs., would give something like 900,000 tons of coal. The seam is said to be 5 feet, but it has never been cut except with boring-rods at B. and C. on the plan.

The largest workable area would probably be on the west bank of the estuary, where no works have hitherto been executed, the land being a Government Township Reserve.

In the area above described no shaft would, I think, require to be carried more than 200 feet in order to obtain coal. I was unable to obtain specimens from which the quality of the coal could be judged; but Captain Vicary states that it is an excellent bituminous coal, ignites freely, and burns with a bright flame. Such being the case, and considering the proximity to the shipping-place, some additional outlay in this locality would, I think, be desirable, and would, if properly expended, in all probability result in the discovery of a workable coal-field."

ADDENDUM to Report on Coal found in the Neighbourhood of Spring Bay.

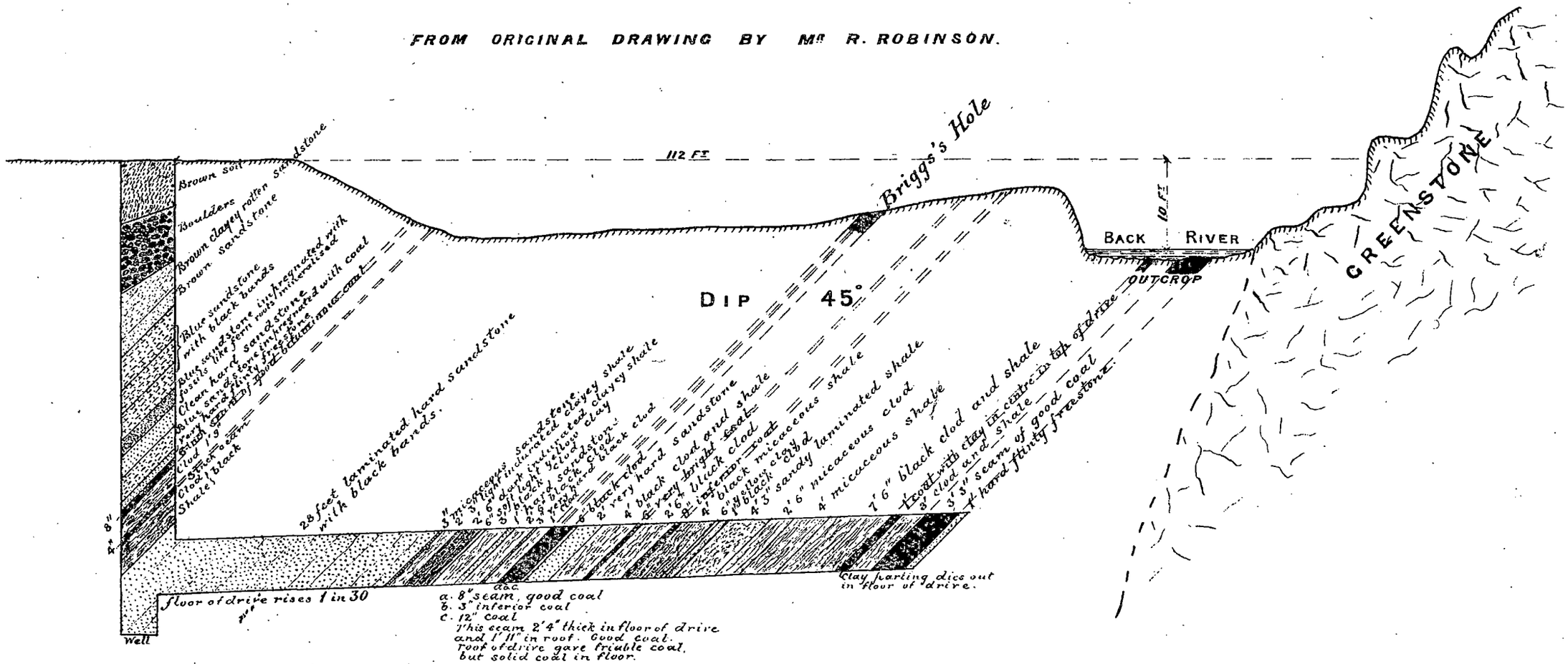
Geological Surveyor's Office, 29th September, 1890.

Sir,

In my Report to you of August 2nd, 1890, on the coal fields in the Spring Bay Municipality, I was unable to give any definite information as to the work that had been done to prove the seams of coal known to crop out in the Back River at Prosser's Plains. Since writing it Mr. R. Robinson, of Triabunna, has shown me a record kept by him of the strata passed through in a shaft and drive which he executed there more than sixteen years ago. This record was in the form of a section, and is of such importance that I have made a copy of it, to a smaller scale, which is attached hereto. The description of the strata is Mr. Robinson's, with one or two unimportant verbal alterations. I have added to the section on the right hand side a dotted line to show the probable occurrence of the greenstone below the surface. The following note on the face of Mr. Robinson's section is of consequence:—"*Note.*—Basalt hill the cause of the

SECTION OF SHAFT AND DRIVE AT THE BACK RIVER PROSSER'S PLAINS

FROM ORIGINAL DRAWING BY Mr R. ROBINSON.



Shaft 50 ft. deep. Drive 80 ft. long. Scale 15 ft to an inch.

upheaval; height of hill, 200 feet; angle of slope, 45 degrees. All the seams of coal gone through have thickened at lower end of dip, and quality of coal improved considerably. If the seams of coal had been struck in the shaft instead of the drive they would have been a deal thicker and harder, as the great difference in the thickness of the seams at the lowest point of dip proves beyond doubt, and likewise the superior quality of coal, as it seems to lose its friableness at the lower end of dip. (Signed) R. Robinson, May 30th, 1874."

From the section it will be seen that seven seams of coal were passed through, two of them being of workable thickness. The improvement in the thickness and quality of the seams noted by Mr. Robinson augurs well for their value when struck at a greater depth. From the information given to me, I gather that the abandonment of these prospecting works was due to the difficulty of keeping down the water, and the indisposition of the owners to go to further expense, rather than to any want of faith in the value of the coal. It is quite likely that still more seams will be found lying beneath those already discovered, and prospecting the strata further by means of the diamond drill is strongly recommended.

So far as the section goes the strata do not appear to be getting any flatter in their dip as we get away from the greenstone. In view of this, I would advise that the first bore executed should be not more than five chains from the outcrop in the river, in place of ten or fifteen chains as formerly recommended. Nevertheless, I still expect that the seams will be found to dip at a much lower angle as they are followed further to the westward. The depths at which the drill strikes the various seams will show if any such flattening is taking place.

The most serious difficulty to be apprehended in testing and working this coal field is that, owing to the proximity of the greenstone intrusions, it is very likely to be broken by faults. It will probably be found that at least three bores will have to be put down before evidence as to this point will be forthcoming. But, should payable seams be proved to exist in a disturbed condition near to the greenstone, there is still every reason to hope that, in the large stretch of sandstone country to the south-west of the outcrop, unbroken areas of considerable extent will be found. There is no doubt in my mind that this locality is well worth the expense of prospecting with the diamond drill.

I have, &c.

A. MONTGOMERY, *Geological Surveyor.*

The Secretary of Mines, Hobart.

Diamond Drill No. 1.

***REPORT** of Strata passed through in boring for Coal in the neighbourhood of Spring Bay.*

No. 1 Bore.

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Surface soil	1	0	1	0
Dark sandy clay	9	0	10	0
White running sand	1	0	11	0
Sandy clay merging into sandstone	3	0	14	0
Soft sandstone	2	0	16	0
Very firm grey post	3	0	19	0
Sandstone, some of it mottled	15	0	34	0
Firm grey post	1	0	35	0
White, sharp, quartzose sandstone	11	0	46	0
Sandstone, getting firmer	25	8	71	8
Coarse-grained, sharp, quartzose sandstone, varying in colour, hard and soft bars	23	4	95	0
Dark brown sandstone, brittle and firm	5	0	100	0
Light grey sandstone	5	0	105	0
Soft coarse-grained decomposed felspathic sandstone, charged with iron pyrites	8	9	113	9
Yellowish green to greyish greasy soapstone, changing in going downwards to dark greenish rather hard soapstone, and finally into diabase greenstone, of which the soapstone is a decomposition product. Joints at 117′ full of concretionary spherules of carbonate of iron	3	6	117	3
Diabase greenstone, fine-grained and decomposed towards the top, but rapidly getting firmer and also of coarser grain. Zeolites in joints and cavity at 162′ 6″	57	6	174	9
Total	174	9	174	9

Bore commenced 25th February, 1891; finished 20th March, 1891.

No. 2 Bore.

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Surface shaft, clay and drift	13	0	13	0
Soft brown sandstone	1	0	14	0
Hard brown sandstone with vertical iron veins	13	0	27	0
Very hard dark shale	1	0	28	0
White shale	0	6	28	6
White brittle sandstone	2	6	31	0
Very hard white shale	1	5	32	5
Hard white sandstone	1	0	33	5
Green sandstone	6	6	39	11
White sandstone	0	4	40	3
Very britile grey quartzose sandstone with vertical fracture	1	2	41	5
Hard quartzose white sandstone	4	7½	46	0½
Hard bluish-grey compact flinty sandstone or quartzite, with conchoidal fracture	0	8	46	8½
Compact grey sandstone or quartzite with almost vertical joints	1	8½	48	5
Hard greenish sandstone with vertical joints much like diabase greenstone in appearance. Altered felspathic sandstone	27	8½	76	1½
Total	76	1½	76	1½

Bore commenced 1st April, 1891; finished 15th April, 1891.

No. 3 Bore.

Strata.	Thickness		Total Depth.	
	ft.	in.	ft.	in.
Surface shaft, heavy boulder wash	23	6	23	6
Sandstone, with coal stains and fern prints	1	6	25	0
Dark greasy shales	7	6	32	6
Dark and light shales	2	8	35	2
Coarse grained friable quartzose sandstone, somewhat micaceous, much stained with carbonaceous matter	10	11½	46	1½
Soft grey post	8	4	54	5½
Black carbonaceous mudstone or clod	0	8½	55	2
Hard white flinty quartzose sandstone, approaching to quartzite	0	5	55	7
Coarse grained very friable dark coloured quartzose sandstone	0	2½	55	9½
Black shale or clod	0	6	56	3½
Soft sandstone with minute fossils	1	1	57	4½
Dark sandstone with calcite	1	3	58	7½
Light and dark sandstones	3	6	62	1½
Black carbonaceous mudstone or clod, with a little coal	0	4	62	5½
Light grey soft shale or claystone	3	1½	65	7
Sandstone with coal stains	4	10	70	5
Light blue shale	1	1	71	6
Light grey argillaceous fine grained sandstone and grey shale	5	0	76	6
Pink shale, iron stained	7	0	83	6
Light sandy shale	5	3½	88	9½
Sandstone	1	3	90	0½
Light blue shale	5	1	95	1½
Light grey shale or fine grained felspathic sandstone, with calcite inter-laminations	6	0	101	1½
Dark firm shale, with calcite veins	4	11	106	0½
Dark blue shale	1	6	107	6½
Very dark shale	0	9	108	3½
Light blue shale	11	0	119	3½
Blue shale or fine grained felspathic sandstone, with fern impressions	2	0	121	3½
Shale varying in character, partly coal-stained grey post or hard fireclay	1	6	122	9½
Pink shale	6	11	129	8½
Firm sandstone	1	6	131	2½
Pink shale	2	0	133	2½
Sandstone	6	2½	139	5

No. 3 Bore—*continued.*

Strata.	Thickness.	Total Depth.
	ft. in.	ft. in.
Brownish felspathic sandstone and shale	3 0	142 5
Conglomerate of sandstone and pink shale	0 10	143 3
Brown shale and grey grit	4 1	147 4
Light bluish grey and pinkish and dark bluish grey arenaceous shale. Impression of *Phyllotheca sp.* at 154 feet	16 8	164 0
Soft sandstone	2 6	166 6
Shales, pink, blue, and sandy	5 0	171 6
Micaceous light grey felspathic sandstone, with coal stains ; a few inches of conglomerate in last foot	33 9	205 3
Hard white flinty quartzose sandstone	4 0	209 3
Fine grained quartzose sandstone, light grey and pinkish, passing into silicious mudstone, with carbonaceous matter	11 4	220 7
Slighly micaceous fine grained sandstone and arenaceous shale. Fine print of *Thinnfeldia sp.* at 230 feet, fragmentary prints of *Thinnfeldia* and *Phyllotheca* at 227 feet and 225 feet	14 0	234 7
Arenaceous shales and quartzose sandstones with prints of *Phyllotheca* and *Zeugophyllites*	13 0	247 7
Pink and light blue fine-grained quartzose sandstone and arenaceous shale	34 4	281 11
Pink shales	5 1	287 0
Green quartzose sandstone, light coloured in places	51 10	338 10
Red sandstone, quartzose, and sharp to touch	1 9	340 7
Green sharp quartzose sandstone, with included lumps of mudstone, forming a conglomerate for a few inches at 394′ 6″, getting hard at 419 feet	82 1	422 8
Solid, very dense, aphanite diabase greenstone, with conchoidal fracture	1 4	424 0
Total	424 0	424 0

Bore commenced 25th April, 1891 ; finished June 12th, 1891.

No. 4 Bore.

Strata.	Thickness.	Total Depth.
	ft. in.	ft. in.
Surface shaft	8 0	8 0
Yellow sandstone, with coal markings	22 0	30 0
Blue sandstone, with coal markings	38 0	68 0
Dark shale	1 8½	69 8½
Coarse-grained sandstone	1 4	71 0½
Coal and shale	0 2	71 2½
Brown shale	1 5	72 7½
Dark shale	1 0	73 7½
Blue shale	3 0	76 7½
Sandy shale	7 7½	84 3
Coal	0 1	84 4
Black clod and coaly matter	1 0	85 4
White shale, with thin coal pipes	0 10½	86 2½
Coal (did not form solid cores)	2 3¼	88 5¾
Brown band	1 0	89 5¾
Black clod	0 10	90 3¾
Coal	0 7	90 10¾
Clod	0 3	91 1¾
Coal	0 3	91 4¾
Black shale	0 3	91 7¾
Sandy shale	1 7½	93 3¼
Soft sandstone	6 3	99 6¼
Dark shale	2 9½	102 3¾
Clod and *coal*	0 2¼	102 6
Sandy shales, with patches of clod	27 6	130 0
Hard white coarse-grained quartzose sandstone, approaching to quartzite	27 0	157 0

No. 4 Bore—*continued.*

Strata.	Thickness.	Total Depth.
	ft. in.	ft. in.
Greasy black clod, with thin seam of *coal*	1 0	158 0
Sandy shale	3 0	161 0
Hard white quartzose micaceous sandstone, with coal stains and thin pipes	3 6	164 6
Sandy shale and sandstones, with patches of clod, full of coal stains	6 6	171 0
Sandstone (quartzose) and shale, variable	7 4	178 4
Dark shale	2 0	180 4
Light band	0 8	181 0
Dark shale	1 0	182 0
Light band	0 3	182 3
Dark shale, with a trace of coal	1 3	183 6
Black clod	4 1	187 7
White shale	3 3	190 10
Coal	0 1½	190 11½
Sandstone, light and dark	5 9½	196 9
Very impure *coal* and black clod	0 4	197 1
Dark shale	3 8	200 9
Sandstone	2 11	203 8
Sandstone and shales, the latter getting lighter in colour	20 4	224 0
Sandstone and shales, two very thin seams of *coal*	15 0	239 0
Light grey fine-grained argillaceous sandstones, with pinkish tinge	22 10	261 10
Total	261 10	261 10

Bore abandoned at 261′ 10″ as having passed into strata already tested by No. 3 bore.

Analysis of Coal from 88 Feet:—

Fixed carbon	52·2 per cent.
Matter volatile at red heat	12·8 „
Mineral matter (ash)	29·4 „
Sulphur	0·9 „
Moisture	4·7 „
Total	100·0 per cent.

Analysis by Mr. W. F. Ward, Government Analyst.

Bore commenced 23rd June, 1891; finished July 18th, 1891.

REPORT ON THE HYDRAULIC LIMESTONES OF MARIA ISLAND.

Geological Surveyor's Office,
Launceston, 19th September, 1890.

Sir,

I have the honor to report, in accordance with your instructions, on the occurrence of hydraulic limestone suitable for the manufacture of Portland cement at Maria Island.

The ground examined is the property of the Maria Island Company, and is situated in the north-western corner of the Island. A plan and two sections of it are appended to this Report, and will be frequently referred to in it.

Geological features.—As will be seen from the map, the western part of the ground is composed of greenstone, similar in every respect to the great greenstone masses of the mainland, well seen in the gorge of the Prosser's River, above Orford, immediately opposite Maria Island. This igneous rock cuts off the limestone formation along a line indicated on the plan. Eastward of this line the country consists of beds of limestones and shales, reaching at any rate to Cape Boulanger; further to the eastward the greenstones and granites again cut them off. The north coast line affords a magnificent section of the strata, as vertical cliffs rise sheer from the beach to a height of as much as 400 feet. It is noteworthy that the ground slopes inland from the top of the cliffs, so that we have the unusual sight of ridges and valleys rising to the coast line instead of falling towards it. This topographical peculiarity is of importance in determining the site for the proposed cement works.

N.

VINEYARD

VINEYARD

Boundary of Freehold

RESERVE

CEMETERY

BANK

GREENSTONE

THE GREENSTONE AND LIMESTONE

APPROXIMATE BOUNDARY BETWEEN

LIMESTONE

DIP OF STRATA (to S.28°E.)

HOTEL

ENGINE HOUSE

STORE

ENGINE HOUSE

OLD KILN

Res.d ROAD ONE CHAIN WIDE

BERNACCHI'S CREEK

PUBLIC RESERVE
4. 0. 17.

Freehold

Boundary of

Res.d ONE CHAIN WIDE

Hd Mudstone without Limestone

Hard Limestone and Calcareous Shale

Calcareous Shales

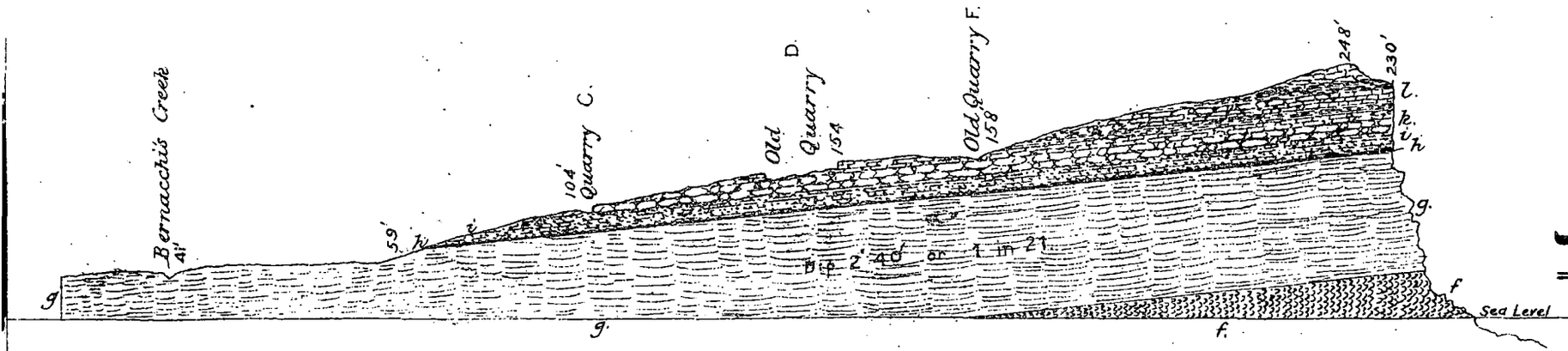
MAP OF NORTHERN PART OF BERNACCHI'S FREEHOLD

MARIA ISLAND

SCALE

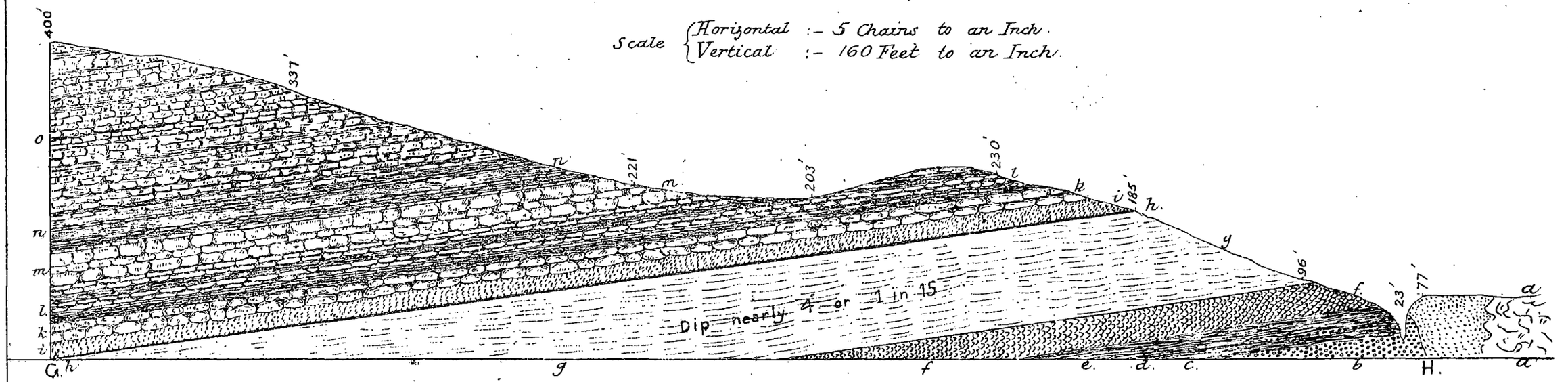
5 CHAINS TO ONE INCH

MARIA ISLAND



SECTION THROUGH MIDDLE SPUR FROM CREEK TO COAST

Scale { Horizontal :- 5 Chains to an Inch.
Vertical :- 160 Feet to an Inch.



SECTION ALONG COAST FROM G. TO H.

a. Greenstone. b. Limestone & conglomerate. c. Calcareous shale & thin beds of limestone. d. Bed of Pachydomus shells. e. Calcareous shales with thin beds of solid limestone. f Thick bed of Pachydomus shells. g. thick bed of mudstones with very abundant remains of species of Fenestella &c. h. bed of volcanic ash. i shaly limestone with numerous species of Spirifera, Productus &c. k. thin bedded hard limestones worked in quarries on Middle Spur. l. horizon of limestone beds worked for cement in quarry A. m. horizon of crystalline crinoidal limestones in bottom of quarry B. n. mixed beds of limestone and mudstone. o. beds of hard limestone seen in face of cliff at G.

It has become customary, locally, to speak of the bands of hydraulic limestone as "Blue Lias," from the superficial resemblance of the stone to the bluish hydraulic limestones of the Liassic period in England. This is quite a misnomer, however, as the Maria Island beds are much older than the Lias, being of carboniferous age; they belong to the lower marine beds of our carboniferous system, which underlie the oldest coal seams yet found either here or in New South Wales. They are extremely rich in fossil remains, the most important of which are named in Johnston's Geology of Tasmania; the genera *pachydomus*, *aviculopecten*, *spirifera*, *productus*, and *fenestella* are very abundantly represented. Owing to the extreme steepness of the cliffs it is not possible to examine the section presented by them so closely throughout as is desirable, but I was able to compile the following section from observations in such parts as could be scaled. It is yet very imperfect, especially in the upper part, where the face of the cliff could only be closely examined by a person lowered over it by ropes. The section includes the strata seen between points G and H on the plan. The direction of the dip is a little more to the south than the line joining these points, being about S. 28° E., but the amount of the angle of dip is low, being only 4°, and the coast line section may be fairly considered as along the line of the dip. The beds in the cliff, therefore, come down to the beach, but cannot be clearly followed there on account of the great amount of fallen débris. The figured section appended shows the main features, but is on too small a scale to show details such as are now given :—

	Thickness.		Description of Beds.	Total Thickness of Strata.	
	Feet.	Inches.		Feet.	Inches.
Crinoid Zone.	320	0	Limestones consisting chiefly of crinoid remains in beds from 6 inches to 4 feet thick, separated by thin shaly partings. This limestone seems very pure, except that it frequently contains bands and masses of chalcedony *(Buhrstone)* formed by the infiltration and segregation of siliceous solutions. The beds of the large quarry at B. on plan belong to the lower part of this series	608	0
Productus Zone.	30	0	Beds of blue hydraulic limestone 6 inches to 4 feet thick, worked in quarries at A. C. D. E. and F. on plan, separated by beds of calcareous shale and mudstone, amounting, probably, to nearly half the whole bulk of the beds. The limestones show fossils of *aviculopecten*, *spirifera*, *productus*, and *fenestella* in abundance; *pachydomus* common, but less frequent. Small stones not uncommon	288	0
Fenestella Zone.	43	0	Shaly limestones, very rich in *spirifera* and *productus*	258	0
	2	6	Dark shaly mudstone	215	0
	1	9	Volcanic ash or tuff, very hard, full of small glittering granules of glassy quartz, felspar crystals common, also fragments of various rocks: decomposes to a yellowish-brown clayey stone, which still shows the glassy quartz granules very distinctly	212	6
	124	0	Mudstones with but little lime, very rich in species of *fenestella*, *stenopora*, &c.	210	9
Pachydomus Zone.	40	0	Thick limestone bed, almost entirely made up of shells of *pachydomus globosus*, but containing a great deal of sand and large stones	86	9
	6	0	Calcareous shale	46	9
	0	9	Solid hard limestone	40	9
	2	0	Calcareous shale	40	0
	2	6	Limestone and shale with *spirifera* shells and a good deal of gravel	38	0
	1	6	Solid hard limestone	35	6
	5	0	Calcareous shale	34	0
	1	6	Solid hard limestone	29	0
	1	6	Calcareous shale	27	6
	5	0	Limestone, almost entirely composed of shells of *pachydomus*	26	0
	1	0	Calcareous shale	21	0
	2	0	Solid limestone	20	0
	1	6	Limestone full of boulders	18	0
	3	6	Calcareous shale	16	6
	4	0	Limestone with a great many stones in it	13	0
	4	0	Conglomerate of boulders of metamorphic slate and sandstone and granite, cemented together by limestone	9	0
	5	0	Impure limestone with boulders	5	0
			Sea Level	0	0

The section is best read from the bottom upwards. The lowest beds, about 87 feet thick, have been aptly called the Pachydomus zone by Johnston in his Geology of Tasmania, on account of the immense number of shells of this genus found in it. It is overlaid by mudstones, forming a bed about 124 feet thick, characterised by extreme abundance of Fenestella fossils. This may be called the Fenestella zone *par excellence*, though this genus is abundantly represented from bottom to top of the section in all the shaly beds separating those of limestone, as well as in the latter themselves. The bed of volcanic ash or tuff, which lies on top of the Fenestella mudstones, is about 21 inches thick; it is found at the foot of the high cliffs just above high-water mark, about 10 chains west of point G. on the map; again, half-way up the face of the steep slope at the head of the deep little arm of the sea, about a quarter of a mile further

west; and again, at the top of the cliff some five chains still further on, at an elevation of 185 feet above sea level. From its peculiar character, quite distinct from any of the associated beds, it will serve as a valuable datum line by which to recognise the stratigraphical position of the beds further inland.

The next zone of limestones overlying the tuff is characterised by great abundance of shells of Spirifera and Productus, and might be called the Productus zone; it is probably about 75 feet thick in all. The succeeding beds of limestone, seen in the section to be at least 320 feet thick, containing very numerous fragments of crinoid stems, may be called the Crinoid zone. While it is convenient to divide the strata into these zones, the prevalence of certain genera throughout the whole of them, and of the most characteristic fossils of one zone in those both above and below it, make it very doubtful if, in the present state of our knowledge, it will be possible to relegate the strata found further inland to them with any certainty. The division is proposed as a provisional one, pending more close examination of the fossil contents of the beds.

It is worthy of note that the boulders found abundantly in the lowest strata are all of metamorphic slate and sandstones and granite; I was not able to find a single greenstone boulder among them, though this rock is now close alongside. This is evidence towards the conclusion that the greenstone is of later formation than the strata of the lower marine carboniferous beds, and that the latter were not deposited on the flanks of greenstone masses as has been contended.

Manufacture of Cement.—The quarries opened to procure limestone for burning have as yet been confined to the lower beds of the Crinoid zone and those below it down to the zone of the Fenestella sandstone. The limestones of the Pachydomus zone have not been worked. It has been suggested that it would be a good plan to build any future works for the manufacture of cement near point H. on the map, and obtain the limestone from the adjacent cliffs. Examination of the details of the Pachydomus zone in the above section will show that for 47 feet above sea level the limestone exists in thin beds separated by bands of shale, and that the largest beds of limestone are full of boulders, which render them quite unfit for cement manufacture. Operations would be necessarily confined to the 40-foot bed of Pachydomus shells. This also contains much sand and gravel, and I doubt very much if it would be found fit for making cement. Its value in this respect can only be ascertained by breaking down and grinding a very large parcel of the stone, say four or five tons at least, and having analyses made of the powder, or, better still, having the ground material burned in a cement kiln by a practical man. Both tests should be made before deciding on this bed as the source of the raw material for the cement manufacture. As this limestone dips under the Fenestella mudstone the quantity of it that could be readily got out, though very large, is yet much less than could be obtained from the beds higher up. Further, the use of this bed would necessitate either hoisting the stone to the works, or having it carried by a tramway along the steep face of the cliffs for probably six or seven chains before a site for works could be obtained lower than the bottom of this limestone, which is only about 47 feet above the sea. Still another objection is that almost the whole of this bed at the point where it appears is on the Crown reserve which fringes the shore. Owing to the dip of the strata the bed is at such a depth as to be useless by the time the Company's ground is reached. Even if this limestone should prove to make good cement it is therefore very unlikely to be worked. The low ground near the engineer's house appears to me to be a much better site for the works than on the north coast; they could then be situated below the quarries, but close to them. Little more than half a mile of tramway, over easy ground, with a grade of not more than a foot in a chain, would connect them with the jetty; and they would be able to be supplied with water from the old reservoir up the creek. The outflow pipe of this reservoir is about 126 feet above sea level, and the top of the embankment about 140 feet. By repairing and raising the embankment, which could be done without very large cost, a fine water supply could be obtained, delivering water to the works under a head of over 50 feet at the least. This water supply could only be brought on to the north coast site by a long race round the western side of the high greenstone hill shown on the plan. The middle spur, on which quarries C. E. D. and F. are situated, will be the best source of the raw material; and I should say that the works should be on the point of the spur below point C. The top of the mudstones would naturally form the bottom of the quarries, and gives thus the approximate level of the hoppers for the stone-breakers. Between this level and the low ground south of the engineer's house there is both fall and space for a large system of works, through which the material could pass from higher to lower levels by gravitation, or with but little handling, to the tramway at the bottom.

The cement made hitherto has been from stone obtained from the quarry at A, with the exception of a little from the one at C; the product was of about the same quality in each case. Owing to the dip of the beds, the stone worked at A will not be found in the southern part of the middle spur, but should come in above the quarry at F. From below C to above F, therefore, it is probable that all the limestones will be of a hydraulic character. The cuttings in the old quarries at E, D, and F, show limestones of exactly similar appearance to that in A and C; though I am not aware that any practical test has been made of them. These limestones are in beds averaging about a foot to eighteen inches in thickness, though often much thicker, and are separated by thin layers of shales; this will render the quarrying extremely easy, though there will necessarily be a good deal of refuse shale to be got rid of; this can be readily run to spoil in the valley on the west of the spurs. Some of the calcareous shale may be found useful to correct the excess of carbonate of lime which is likely to be found in some of the limestone beds. Without much more accurate surveys than have yet been made, it is impossible to form any close estimate of the quantity of material here available, especially as we cannot yet tell what proportion of the whole will have to be rejected; but I do not think that a million tons would be too high an estimate of the probable quantity of limestone in the spur between C and the coast. Still more can be obtained along the base of the spur which runs from the point G down to the quarries at B. The upper part of this spur is all composed of the Crinoid limestones seen in quarry B, which are of too pure carbonate of lime to be of use except in

small quantities for correcting any deficiencies in lime that might be found in the lower hydraulic beds. The latter dip under the Crinoid strata, and the amount of stripping would be too great to allow them to be profitably followed into the hill to any great distance; but all the lower ground round the foot of the spur could be worked from near the coast to the present kilns and on up the creek for a long distance. The supply of raw material easily reached is therefore practically unlimited.

All the conditions appear very favourable for advantageous and cheap working, provided that the quality of the hydraulic limestones is uniform and suitable; this has yet to be ascertained. The owners have satisfied themselves that the cement made from quarries A and C is of first rate quality. This is not a question for me to pronounce upon, and the reports of the specialists who have examined and tested the cement must speak for themselves; if they are as favourable as I was informed they were, what has been proved is that one of the lower, (C), and one of the higher, (A), beds of the strata of hydraulic limestone has been shown to make good cement. As to the intermediate beds we know nothing, except that they appear to the eye to be identical with those tried; this is not, however, sufficient proof to warrant the expenditure of a large capital. It is now necessary to open up the whole bed of probable raw material from top to bottom, by means of cuttings into the middle spur at various levels, or by means of shafts sunk along its course; in cases of this sort analyses of small samples are more likely to be delusive than useful, and so sufficient quantities must be taken to give practical working tests which will prove the average value of the stuff. With the machinery on the ground as it is, it would be no difficult matter to practically test a parcel of, say ten tons, of limestone taken as evenly as possible from all the various beds. The stone should be put through the stonebreaker and mills and reduced to powder; the bulk of this should be bricked and burned at some well known and reliable cement works, and small parcels analysed. The opening of the beds by such a test would also give an approximate estimate of the amount of refuse shale and mudstone that will have to be rejected, thus allowing a fair estimate to be made of the quantity of material that can be got from a given area, and the cost of winning it; the expense of making it is, of course, considerable, but it would be most rash to erect expensive works without so doing.

I would recommend open cuttings and shafts for testing the ground rather than drills, unless, indeed, enough bores were executed to secure enough weight of cores for a working test, as it is of the utmost importance to secure samples which will fairly represent the average composition of the mass. In order to produce cement of a uniform quality it will be necessary to have uniformity in the raw material. This contains occasional stones, shells, and shale bands, which cannot be got rid of altogether before going into the grinding mills. It will have to be managed so that the percentage of deleterious materials will never exceed a certain amount. Taking a large sample for the preliminary tests will be the only way to secure that the deleterious substances are duly represented, and are not either in excess of or below the average. In actual working it will doubtless be arranged that the stonebreakers will be fed from a large paddock of broken-out limestone, brought indiscriminately from all parts of the quarries, so as to keep the material always of the average composition. It is important that the preliminary tests should be of material as near as possible to this average composition. I lay great stress on these matters, because it is not always understood by the general public how continually varrying is the composition of any given limestone bed, and how essential it is for good working that the material treated should be of uniform quality.

Disturbances of the strata.—Among the numerous troubles frequently arising in working such deposits as those under consideration, the occurrence of faults in the strata is often to be numbered. In the present case there does not appear to be any reason to anticipate that any such will be found, the beds being, as far as can be seen just now, quite undisturbed. In the top of B quarry, however, there are signs of flexure of the strata to a small extent, which is probably only local. The test pits and cuttings above recommended would settle this question also. Should faults be found to occur it is quite conceivable that a different arrangement of the works would be required from that which would be otherwise adopted. This is not likely, but still possible.

Buhrstone.—Throughout the Crinoid limestone beds occur numerous irregular bands and masses of cellular chalcedony, very similar to buhrstone. On the beach below the high cliffs large quantities of this may be seen, and flat pieces of considerable size are common. If this stone should prove to have a commercial value for milling purposes there would be no difficulty in obtaining it in considerable quantities. I cannot speak as to its practical value.

Taking into consideration that good cement has already been made, and that there are extremely good facilities of all sorts for making and shipping large quantities of it, there is every reason to hope that this important industry will soon be established and flourish in Maria Island.

I have, &c.

A. MONTGOMERY, *M.A., Geological Surveyor.*

The Secretary of Mines, Hobart.

REPORT ON THE PROGRESS OF THE MOUNT ZEEHAN AND MOUNT DUNDAS SILVER-LEAD FIELDS.

Geological Surveyor's Office, Launceston, 25th November, 1890.

SIR,

In accordance with your instructions, I have again visited the Mount Zeehan and Mount Dundas Silver-Lead Fields, and have now the honour to report on the progress visible since my former visit in March last, and on the state of the fields generally. I shall frequently have to refer to my previous "Report on the State of the Mining Industry on the West Coast" of 25th April last, as the present Report is supplementary to it.

MOUNT ZEEHAN DISTRICT.

The progress made in the Mount Zeehan District has been rather in surface work than in developing the lodes. This is largely owing to the fact that in most instances the mines have to be equipped with drainage machinery before sinking on the lodes is possible. In such cases as it has been possible to work by means of adits, steady underground mining has been carried on with more or less success. Where sinking must be done, it has not been possible to get the necessary plant owing to the very wet weather that has prevailed. This made the road from Trial Harbour to Zeehan impracticable for heavy loads, so that boilers, engines, and pumps could not be brought from the coast even when they could be landed there, which has been far from often. At best only comparatively light machinery can be imported by this route, and as this would have soon to be replaced by more powerful plant, it is better for the owners of mines to get the latter in the first place, even though this course involves awaiting the completion of the Strahan-to-Zeehan Railway. Some of the companies, it is true, have at great expense got drainage machinery up from the coast, but the necessity for more powerful plant has been exemplified lately in the case of these same mines, the Silver Queen and Argent mines having been flooded out, while the Mount Zeehan (Colonial) Company has barely been able to keep the water down by working the engine much above its proper speed. It is quite clear that economy demands the erection of powerful engines at once, and that small temporary ones are only thrown away. The difficulties with water experienced last winter are very largely due to the great amount of rainfall, and during the summer they may may be expected to be much less troublesome. As the surface of the ground becomes cleared, drained, and grassed, so that the rain water will not lie on it, but run away into the watercourses, less water will be found underground. The clearing and drainage of the sections is therefore of considerable consequence, and should be pushed on with when other work is slack.

The Township of Zeehan has grown very much, and buildings are going up in every direction, proving the faith of the residents in the future of the field. Tracks have been made to most of the sections, and if a great deal of prospecting has not always been done, preparations for it in finer weather have thus been undertaken. On a large number of sections prospecting has been carried on in spite of all difficulties, and on some with great energy and vigour. There are still, however, too many of them on which absolutely no work has been done. The popular excitement over the discoveries at Mount Dundas causing attention to be diverted from the older field, has doubtless been responsible for some of this neglect, but it is also indubitable that some of the lessees have no intention of working their ground until they are forced to do so. Everywhere there is plenty to do that ought to be done without delay. Even if ore cannot be raised for want of engines, there is a great deal to be done in tracing the lodes, preparing machinery sites, cutting and sawing timber for buildings, making roads and tramways, and generally preparing for getting briskly to work when the railway is ready to bring in the machinery.

In my former Report I have referred to the volcanic rocks found throughout the Zeehan District as being in most cases probably dykes of a rock allied to diorite. The new work in Balstrup's, the Manganese Hill, and the Silver Queen mines, and the extensive prospecting trenches and tunnels of the Silver Queen Extended Company, have, however, thrown much new light upon the subject, and I am now of the opinion that these masses of clayey rock are really, in most instances, tuff-beds lying between the beds of silurian slate and sandstone conformably, and therefore being, like the latter, frequently inclined at high angles of dip. In the clayey rock between the two lodes in the Western mine a bed of volcanic breccia containing scoriaceous fragments has been found dipping almost vertically. In the second crosscut in Balstrup's mine the bedded structure of the tufaceous rock is also very apparent. On the Maxim section it is very clearly seen, the beds being thin and of different colours and textures. One of these, of very white colour and standing vertically, had been trenched upon, and was about to be further exploited by an adit in the belief that it was a kaolin lode. These tufaceous rocks must have been deposited in the waters of the silurian sea, partly probably as showers of volcanic ashes falling upon the water, and partly as ashes washed into the sea in immense quantities immediately after eruptions, at the time when what are now slates and sandstones were being deposited as sediments. It is quite possible, and probable, that flows of lava and the intrusion of dykes accompanied the pouring forth of showers of volcanic ashes, and consequently some of the volcanic rocks now found may prove to be of the former nature. As the workings of the mines extend, the relationship of the volcanic rocks to the slates and sandstones will doubtless become more clear. The question is one to be studied with practical interest by miners on the field, as a radical difference in the country rock in which lodes occur is extremely likely to be accompanied with a difference in their ore contents.

The following brief notes on the various properties visited will show the progress that is being made. Many sections are not here mentioned at all, as I had not time to go to them, though I believe that I visited almost every one on which any work of consequence was being done, the only exceptions I know of being the Silver Duke, Oonah, and Junction Companies' holdings, on all of which work was going on, but which I could not make opportunity to go to.

Silver Queen.—(Sections 1666M., 1636M., 1641M., 1642M., 1637M., 1638M., 1639M., and 1640M., Visited 11th October, 1890.)

Work from the main shaft in Section 1637M. has had to stop on account of the mine being flooded. This disaster has been compensated for by the discovery of a new and very rich lode on Section 1638M. This was first cut on the side of the main road, 2·64 chains from the west and 7 chains from the south boundary of the section, as a mere seam of whitish clay, but on following it it increased in width and soon showed carbonate of lead rich in silver. The drive on it goes N. 40° E. for 142 feet, then N. 68° E. for 38 feet. In this the lode averaged about 20 inches in width, varying from 12 to 30 inches. Excellent high grade ore was obtained for about 140 feet, when the country changed from tufaceous rock to black slate, and the lode became pinched and the ore dipped underfoot. Since my visit a winze has been sunk at this point and a drive southward, that is, back towards the mouth of the first adit, has been constructed. I saw several bags of ore from this, consisting mostly of galena crusted with cerussite (the carbonate of lead). It was very pure ore, and, according to the Company's bulk essays, very rich in silver. I was informed that the lode in the winze and drive had widened out to from 3 feet to 3 feet 6 inches. The ore in the upper drive was at first mainly cerussite, containing some blue and green carbonates of copper, a little quartz, and some clay, but as work progressed a good deal of galena made its appearance. The lode is evidently making into galena at no great depth. At the time of my visit 98$\frac{3}{4}$ tons of high grade carbonate ore had been sent to Trial Harbour for shipment, and since then a great deal more has been sent. The purity and high silver value of the ore in this lode have made the discovery a most valuable one, and if the shoot goes down to a depth, as it may fairly be expected to do, it will be a real Bonanza for the Company. When I saw the workings it appeared as if the ore was going to be confined to the tufaceous country. It will be very interesting and instructive to notice if it goes into the black slate country at a greater depth.

The course of this lode should carry it into Section 1639M. In this another tunnel has been driven north through hard tufaceous rock from a point eight chains from the south, and six chains from the east boundary of the sections. On the surface of the ground above the tunnel there is a great deal of loose brown iron ore, and a piece of carbonate of iron carrying galena and blende was found just at its mouth, so that there is reason to believe that there is a lode in the near vicinity. A small vein of iron-stained clayey matter crossing the drive yielded a few bags of ore assaying 54 ounces to the tons in silver, and assays show that the country rock itself carries a little of the precious metal.

The discovery of the cerussite lode on this property has been of great service to the Zeehan field by recalling public attention to it when all eyes were fixed upon Dundas. It has also led to a great deal of prospecting being done, especially in the tufaceous formation. Numerous assays have shown that this rock often contains a small quantity of silver, and it is therefore likely to prove a good matrix for rich lodes.

Balstrup's Manganese Hill—(Section 1209M. Visited 11th October, 1890).

This mine shows a great improvement since I last saw it. At 370 feet from the mouth of the adit a crosscut has been put in to the north, which struck the lode, six feet wide, at from 12 to 18 feet, and was then continued to a distance of 240 feet without any further result. The country was turfaceous rock all the way. An airshaft 130 feet deep having been sunk on the lode where struck by the crosscut, a drive on the lode easterly was then begun, and had been driven 195 feet when I saw it. In this the lode proved to be from six to eight feet wide as a rule, and consisted of iron and manganese oxides, with occasional crystals of cerussite, but not payable. In the face a change had just come in when I saw the mine, the ore having changed to carbonate of iron with lode-slate and strings of galena, though the latter was not yet in payable quantity. Some antimonial lead ore, assaying from 114 to 120 ounces of silver to the ton, was also found here, and the width of the lode increased to 15 feet. From the frequent occurrence of cerussite crystals in the gossany portion of the lode, together with their absence in the outcrop on surface, the inference may be drawn that the lode is improving at a depth. The assays of the stuff from the drive, too, show a considerable impovement in their silver returns over those of the surface stuff. It appears as if during the alteration of the lode-matter of the outcrop under the influence of surface waters and their dissolved gases, which resulted in the formation of iron and manganese gossan, both lead and silver have been leached out and probably carried to a lower level. Where the atmospheric influence stops at or about the water level, the lode will probably be found to be enriched by these solutions from the higher portions. A winze is to be sunk shortly in the floor of the drive on the lode to try if the lode continues to improve with depth. As galena and carbonate of iron have been found in the drive, it is possible that as it gets further into the hill a considerable portion may be found to be unaffected by surface oxidation, and good ore may be stoped from above the tunnel level; but should the gossan extend down to water level it is extremely likely that the good ore will lie rather below the tunnel. Should this prove to be the case the mine will have to be worked from a shaft.

A second crosscut has been made to cut the lode, starting from a point 806 feet from the entrance to the old adit. It was in about 200 feet when I saw it, but had not yet reached the lode. It passes through a turfaceous rock containing fragments of slate in places.

In my former Report, and the map attached thereto, I find that through some mistake I have marked Balstrup's lode as running S.W. and N.E., whereas it should be N.W. and S.E., the outcrop running through the south boundary of the section, about 4 chains from the S.E. corner, and then running on through Sections 724-87M and 741-87M. It is very strongly marked, the ironstone often rising into a high ridge or wall.

This mine looks very promising, and I have great hopes of its turning out well. As it is typical of a large number of gossan lodes in the Dundas District, its further development will afford much information as to their probable behaviour in depth.

Despatch—(Section 243-87M. Visited 12th October, 1890.)

No work is just now being done upon this Section, which is in very low wet ground. A lode which, from its bearing and position is very likely to be the Silver King lode, is cut in it in several trenches. Course N. 35° W. It passes through the northern boundary of the Section, about 2½ chains east of the N.W. corner-peg, running into Section 1666M of the Silver Queen Company. It is from 3 to 7 or 8 feet wide in the various trenches, shows gossan and galena, and has been traced almost through the section.

The Silver Queen lode in Section 1666M, mentioned in my former Report, crosses the north boundary of this Section about 7 chains east of the N.W. corner-peg. As the course of this is only 15° to 17° W. of N. it should run into the first-mentioned lode about 10 chains south of the north boundary line. This should be a good mine when opened, but will require plenty of power to deal with the water which accumulates on the surface in the wet season.

Silver Crown—(Sections 197-87M, 198-87M, 199-87M, 201-87M, 736-87M. Visited 12th October, 1890.)

The tunnel in Section 736-87M, mentioned in my former Report, has since been driven to within 40 feet of the shaft, without striking the load. The shaft is down 56 feet, and has yet to be sunk 24 feet to connect with the tunnel. When the connection has been effected the lode in the shaft will be followed, and judging from the quality of the ore obtained from the shaft, the stopes should produce payable galena. As the lode in the shaft has varied very much in size, and been at times much split up, some work must be done before the quantity of ore that can be raised can be estimated.

No other work is going on upon these sections, which are mostly open swampy button-grass land. A good deal of trenching has been done with sufficiently favourable results to show that the ground deserves better than to be let lie idle. It appears to me a most promising property. In Section 197-87M, about 4½ chains from the east and four chains from the north boundary, a lode, said to be 7 or 8 feet wide, was cut in a trench now full of water. The ore is galena, with a gangue of siderite (carbonate of iron). This lode requires further tracing. The Silver Queen lode of Section 1666M is likely also to be fouud in this section, and Section 201-87M ought almost certainly to have the Despatch lode. In Section 197-87M also their is a large outcrop of ironstone, carbonate of manganese, siderite, and oxide of manganese, carrying a little galena, situated about 5 chains north of the middle of the south boundary. As far as can be seen from the trench, the width of lode is about twenty feet, and its course N. 32° E., but the latter is not at all clear. There are four or five veins, carrying galena, cut in trenches close to this large lode, and a little further to the north there are several others. As the trenches were full of water I could see nothing of the size of these. Nothing can be done to test this ground without machinery to drain the workings, but it appears to me that the prospects warrant giving it a thorough trial.

Silver Crown Extended—(Section 848-87M. Visited 12th October, 1890.)

A great deal of trenching has been done in low ground on this Section, without much result, except the finding of a little loose galena associated with blende. The depth of the loose surface soil and the wetness of the ground have prevented the lode, if there is one, from being found in solid country. The galena found in the trenches appears to be taking a course about N. 2° W. The indications here are as yet not very promising, but perhaps in the dry season it might be possible to sink a few feet on the galena veins and learn if they become more defined.

Western—(Sections 755-87M, 756-87M, and 854-87M. Visited 12th October, 1890.)

Work in this mine has been steadily carried on since I last reported upon it. The lower adit is now 502 feet, the country passed through having been all curly black slate. In the upper adit, the No. 2 lode has been driven on for 187 feet. At 100 feet it split, and the eastern leg was followed for 87 feet, but at 65 feet from the split the lode dipped away under foot. A crosscut was then put in to the westward a distance of 58 feet, where the other leg of the lode was cut. This was from one to three feet wide. In the crosscut several veins of galena one quarter inch to two inches thick were cut through, all dipping westerly towards the main vein. This has now been driven on for 16 feet, and, though small, furnishes a fair quantity of very good galena. The country rock is tufaceous. On the No. 1 lode the northern drive has been extended to 131 feet in hard black slate. The lode is now very small, only showing about three inches wide in the face.

The manager informs me that altogether 96 tons 3 cwts. of ore have been exported from the mine, 33 tons having come from No. 1 lode, 56 tons from No. 2 lode, and 8 tons from No. 3 lode. About 50 tons of second-class ore from No. 2 lode are now on the surface. In spite of the high charges for freight to Trial Harbour, the ore exported has returned enough profit to pay for the mining work that has been done.

The drive on No. 2 lode has yet to be extended some 200 feet before connection can be made with the lower adit. This will require a winze 40 feet deep. From the lower tunnel to the surface there will be about 94 feet of backs on the lodes, so that a large quantity of ore can be got from the stopes. Should the adit strike No. 2 lode carrying ore there will be a length of over 300 feet of it to be stoped to surface from the upper level. This mine has very fair prospects before it.

Mount Zeehan Silver-Lead Mine—(Sections 559M and 909M. Visited 13th October, 1890.)

On Section 559M underground work has been pushed on with at the 120 and 60 feet levels. Water has been very troublesome, and the pumping engine has had to be run to its utmost capacity. A much more powerful one is urgently required. The lodes have been rather poor, though occasional bunches of ore have been obtained. The manager estimates that he has 80 tons of first-class ore and about 400 tons of second-class at grass. This mine is being well worked, and deserves greater success than it has yet had. I feel confident that it will be a large producer of ore in time.

Manganese Hill—(Section 724-87M. Visited 13th October, 1890.)

In this property an adit is being driven from the lowest level obtainable to cut a large outcrop of ironstone and oxide of manganese which runs through the north-east corner of the Section, and is almost certainly part of Balstrup's lode. The tunnel had been driven 470 feet at the date of my visit to it, and had yet to go another 200 or 250 feet to reach the lode. The country is easy for driving, being clayey, vertically bedded turfaceous rock, often enclosing angular fragments of brittle slate. Till the lode is cut nothing can be said as to the future of this mine. The outcrop is of a favourable nature, and there is good likelihood of ore being found at a greater depth. It remains to be seen if the adit is low enough, or if it will be necessary to have a shaft.

The Silver King—(Sections 217-87M, 218-87M, 219-87M, 220-87M, 221-87M, 222-87M, 223-87M, 468-87M, 469-87M, and 470-87M. Visited 14th October, 1890.)

So far as work on the lodes is concerned, this property is just as it was when last reported on. all energies have been devoted to getting the winding and pumping machinery erected at the main shaft After great difficulties and expense this has now been practically completed, and sinking and exploitation of the lode should now proceed rapidly. The erection of machinery was not quite completed when I visited the mine, but was nearly so, and the formal starting of it has since been reported in the newspapers Should the lodes in depth come up to the promise of the surface prospects, this Company should soon be paying dividends.

Silver Bell—(Section 480-87M. Visited 14th October, 1890.)

The tunnel on the lode in this excellent little property has been extended to connect with the shaft. I was so unfortunate as to visit the mine when all the men had gone away for some reason, and consequently could not get accurate information as to the distance driven. A large quantity of splendid-looking ore is stacked on the surface, and I quite believe the current report that its value is nearly, if not quite, equivalent to the nominal value of the mine as shown by the price of the shares. The drive has been in ore throughout its whole length, and ore is known to be underfoot, therefore ready to be taken out when drainage machinery shall have been erected and a lower level can be driven. This mine gives promise of being one of the best on the field.

T. L. Fowler's Section—(547-87M. Visited 14th October, 1890.)

In this section a lode, which from its position and mineral character has been conjectured to be Balstrup's has been cut by trenches in two places in low-lying ground. In neither trench has the outcrop been completely cut through, but it is evidently a wide one, quite 20 feet of it showing in the trenches. The course of the lode as taken from the trenches is about N. 25° W., which is much too northerly for Balstrup's lode, but may be only local. The outcrop contains a great deal of carbonate of manganese in rose-red crystals, also oxide of manganese, and a good deal of carbonate of lead. As Balstrup's lode is characterised by richness in oxide of manganese, which would result from the oxidation of the carbonate, the large quantity of the latter found in Fowler's lode favours the belief that they are identical. Nothing has been done on this property for some time, and it will require machine drainage before the lode can be worked to any depth. It appears to me to be well worth developing.

F. G. Duff's Section.—(1148-87M. Visited 14th October, 1890.)

A new find is here just being opened out. The lode is about 10 feet wide, and runs about north and south, as far as can be seen at present. A small adit has been driven to cut it. In this the lode is mainly made up of lode-slate mixed with galena, though the latter is not yet found in payable quantity. Where seen on surface, in the side of a creek, it is mostly siderite impregnated with galena and blende. Though nothing payable is yet in sight, the lode is worth prospecting.

Bell and Hall's Sections.—(419-87M., 420-87M., 421-87M., and 422-87M. Visited 14th October, 1890.)

Very little has been done to this since I last saw it, only a few trenches having been dug. In these nice crystals of carbonate of lead are freely obtainable in the gossan. Course of lode N. 30° W. The prospects of this lode are much too good for it to be lying idle as at present. A geological point of great interest occurs on this ground. In the bottom of a trench through some loose masses of ironstone, at the main outcrop near the centre of the property, I found a magnesian limestone containing fossils belonging to the marine beds of the coal measures; fragments of a *stenopora* being most common. It is probable therefore that a portion at least of the flat ground in the valley, in which these sections lie, is occupied by strata belonging to the coal measures, instead of the usual silurian rocks. What extent of these latter rocks there is will be known only when some more work has been done on the ground. I do not anticipate that there is more than a small patch; but as I subsequently found coal-measure strata in the vicinity of the Big Henty River, it is quite possible that these latter rocks occur in several other of the low-lying valleys between Mount Zeehan and Strahan. As I found shales carrying fossil ferns beneath the marine beds at the Henty, it is quite possible coal may exist in the formation, and some of the patches of coal-measure rocks might prove valuable. An analysis of the limestone made by Mr. S. Cullingworth, assayer to Balstrup's Manganese Hill Company, was kindly given to me by Mr. J. F. Heighway. It was made to test its value as a flux for smelting, and was as follows :—

Lime, 34·35 °/₀ CaO.
Silica, 8·00 °/₀ SiO_2.
Magnesia, 10·89 °/₀ MgO.
Iron and Lead not estimated.

These figures indicate a percentage of carbonate of lime ($CaCO_3$) of 61·34, and carbonate of magnesia ($MgCO_3$) 22·87. Being low in silica, this limestone would prove useful if no better were available; a much better limestone has, however, been found on the Pyramid Company's ground.

Pyramid—(370-87M. Visited 14th October, 1890.)

Work has been abandoned for some time on this Section, presumably because machinery is required in order to sink on the lodes. Two strong lodes have been found and exposed in trenches close to the large creek which runs through the section. The larger of these two is quite 12 feet wide, course N. 65° E., dip to N.W. A vein of calcite over a foot wide runs along the footwall. The lode is composed of calcite, carbonate of iron, and galena, and has a distinctly banded structure. There is a splendid show of galena, well seen by the lode having been stripped for about 30 feet along its course. The second lode runs into the first; it is about 9 feet wide, course N. 25°W., and shows a large body of fair galena ore. It cannot yet be seen whether the two lodes join one another, or whether one crosses or is thrown by the other. The N. 25° W. lode runs into a high hill on the south side of the creek, and may perhaps be worked by an adit, but as it rises up the hill it appears to be much oxidised to gossan, and it may prove to contain ore only at or near water-level. On the north side of the creek I am not aware if this lode has been found. If it crosses the other lode at all it should be found on that side running into another steep hill suitable for tunnelling. There is a really fine show of galena ore in this property; I am informed, however, that it assays much below the average of the field in silver.

The stuff thrown out from a small shaft that had been sunk close to the intersection of the lodes consists of a very pure limestone of light yellowish-grey colour, apparently the country rock. One sample of it, assayed by Mr. Cullingworth, gave—

Lime, 52·2 °/₀ CaO.
Silica, 6·7 °/₀ SiO_2.
Traces of Iron and Magnesia.

The lime is equivalent to 93 °/₀ of carbonate of lime. Another sample taken by myself was analysed by Mr. W. F. Ward, Government Analyst, with the following result:—

Lime	51·1 per cent.
Magnesia	1·3 per cent.
Oxide of Iron	1·5 per cent.
Silica	4·1 per cent.
Sulphuric Acid (SO_3)	traces.
Carbonic Acid, moisture, and organic matter lost on ignition...	42·0 per cent.
TOTAL	100·0 per cent.

Mr. Ward says, "a minute quantity only of iron pyrites was found. Limestone of this quality would form an excellent flux."

These analyses show a very good fluxing limestone, and as it occurs close to the railway line it can be readily carried to wherever it may be required. This discovery will probably result in smelters being established on the field instead of at Strahan.

The Pyramid property is a genuinely valuable one, and only requires to be taken in hand by a Company strong enough to work it to become a large producer of ore.

Grubb's—(Sections 1562-87M., and 1580-87M. Visited 26th October, 1890.)

Almost no underground work has done on this ground since my last visit. From the drive on the west side of the creek a few tons of excellent galena and cerussite ore have been taken from the small lode encountered in it. A machine site has been levelled, and a main shaft sunk to the adit level, and poppet legs have been erected. A manager's house, office, and several other buildings have also been built, and all energies are now devoted to the construction of a tramway which is to connect the mine with the terminus of the Strahan-to-Zeehan Railway, on the Silver King Company's ground. This tramway is projected to be 3 feet 6 inches wide, with no steeper grade than 1 in 40, and no curve of less than 5 chains radius, being in these respects the same as the railway. If carried out on these lines it will be a very excellent tramway. I cannot, however, see the necessity of having so expensive a one in the present state of the mine; a narrow-gauge light tramway would answer all purposes for a long time. If the line is to be carried out as at present proposed it should be laid with heavier rails, the same as those on the main line, so that the railway trucks might run right up it without transhipment. The tramway will be close on 3½ miles in length; it will be of great service to many other Companies besides this one.

Tasmanian—(Sections 1468-87M., 1467-87M., 1469-87M., 1688-87M., 1470-87M. Visited 26th October, 1890.)

The work done on this property also since I last saw it is principally preparatory. A site for an engine-house has been levelled, and a main shaft 63 feet deep has been sunk and connected by a crosscut 55 feet long with the main adit. It is now proposed to bring a tramway in from the main road at the Comstock to the mine. On Section 1470-87M. a shaft has been sunk 78 feet through a clayey tufaceous rock full of green talcose particles. About 3 feet of the clayey lode formation containing pyrites and a little loose galena were passed through in this shaft, which is about 2 chains from the boundary of Section 1005-87M., and 10 chains west of the boundary of 1681-87M. It was sunk to look for No. 2 lode.

Block No. 1, *Britannia*—(Section 1005-87M. Visited 26th October, 1890.)

Some prospecting has been done on this section in the endeavour to pick up the Tasmanian Co.'s No. 2 lode. About a chain north of the south boundary an adit close on 300 feet in length has been driven due west; at about 130 feet from the mouth, about which distance the lode was expected to be met with, two small strings of quartz and pyrites were cut, but nothing more definite.

About a chain from the northern boundary some trenches have been dug in which quartz highly charged with pyrites and containing a few specks of galena has been got. Owing to water the trenches could not be sunk to any depth. The galena was rather more abundant towards the bottom of the trench. This Company has evidently yet to find its lode.

Mount Zeehan (Tasmania) Silver-Lead Mines, Limited. (Visited 26th and 30th October, 1890.)

This English Company holds nine Sections, which are generally known by the names of the Companies that formerly held them, but as some of these are still in existence, having sold only part of their ground, this nomenclature leads to confusion. The manager has, therefore, decided to call them by Block numbers, as follows :—

Block No. 1. 193-87M., formerly held by the Argent Company.
Block No. 2. 192-87M., ditto ditto.
Block No. 3. 1643M., ditto Silver Queen Company.
Block No. 4. 1665M., ditto ditto.
Block No. 5. 189-87M., ditto Silver Queen Extended Company.
Block No. 6. 196-87M., ditto Silver Spray Company.
Block No. 7. 195-87M., ditto ditto.
Block No. 8. 994-87M., ditto Britannia Company.
Block No. 9. 2154-87M., ditto Montana Company.

Since taking possession of these properties the Company has been working vigorously to get them into a producing state. A tramway is being made to the site chosen for the smelting furnaces, and bricks are being made on the ground for these and for general use. The machinery erected on Block No. 2 by the Argent Company has proved unequal to its work, the water rising in spite of the engine, so that underground work has had to be abandoned here for a time. The pumps on Block No. 5 are, however, at work, and sinking and driving are being proceeded with. A new shaft is also being sunk on Block 5, and is now down over 55 feet. This shaft is about 80 feet from a lode known as No. 4, and 55 feet from another known as No. 3. The former strikes N. 10° E., and the latter N. 55° E. They run together in the small creek passing through the Block. Both these lodes are small, but they show from 4 inches to 6 inches of galena frequently. The main shaft is situated 4½ chains from the north and 245 feet from the east boundary of the block. No. 1 lode is 100 feet west of the shaft; it shows a lot of galena on surface, runs N. 7° E., and is from 2 to 5 feet in width. About 386 feet further westward No. 2 lode is encountered. Some very fine galena was obtained from a small shaft on this, which is now full of water, preventing the width of the lode or its course from being seen; the lode has not been trenched on surface, and its course is not certainly known, though supposed to be about N. 10° E. From No. 2 lode to the junction of Nos. 3 and 4 is about 400 feet. It is intended to drive a crosscut westward from the main shaft to the new shaft, cutting the various lodes; the new shaft will then serve as an air shaft.

On Block No. 9, the old Montana Company's section, the lodes have been stripped a good deal and better traced than when I last saw them, and a large quantity of good galena has been stacked. Work is progressing vigorously on this block.

On Block No. 8 nothing is being done at present. In this a lode containing galena and blende with much pyrites has been cut in a trench in about the position where the Tasmanian Company's No. 2 lode might be looked for, but the course was about north and south where I tried it with the compass. It is said to be three feet wide in the trench, but as the latter was full of water I could not verify this. Close to this lode is a large gossan outcrop, mostly composed of brown oxide of iron, into which a short tunnel has been driven without cutting through it. This ironstone is reported to have assayed well, and has evidently been thought worth saving, as there is a neat heap of it stacked outside the mouth of the drive. The gossan can be traced in a north-westerly direction on surface for a considerable distance.

From a conversation with Mr. Elliott, the manager of the British Company, I gather that the smelting furnaces will be of two types,—ore-hearths for treatment of rich pure galena, and water-jacket cupola furnaces for the re-smelting of the slags from the ore-hearths, and for less pure ore. Such ore as is too poor in lead for furnace treatment is to be concentrated by means of jigs and buddles. From the energetic way in which the Company is working it should be but a short time before the necessary plant is on the ground. The blocks of land secured comprise several of the best-looking "shows" on the field, and the Company should reap a rich reward for its enterprise.

E. Dardus's Section—(1635-87M Visited 27th October, 1890.)

In passing over this lease on my way to the Silver Stream, I noticed that several small gossan lodes had been cut in shallow trenches on top of a ridge. Nothing has been done to prove their extent, or if they carry anything of value.

Silver Stream—(1642-87M. Visited 27th October, 1890.)

Some trenches in low-lying swampy ground have obtained good pure galena in black surface soil, but at the time of my visit there had always been too much water to allow of sinking into the solid rock below. The galena in the trenches appears to be following a definite line, about N. 10° E., and in all probability a lode is close underneath. Some of the galena was said to have assayed 129 ounces of silver to the ton. In one of the trenches some ironstone was obtained containing native copper. A small shaft is being sunk to test the ground further. In another part of the section a tunnel has been driven 66 feet to cut across a continuation of the Tasmanian Prospecting Company's magnetite lode. The magnetite in this tunnel was very soft and friable; no lead or silver ore was found with it. Should the loose galena be traced to a lode this property might turn out well; when I saw it its success was quite problematical.

Tasmanian Silver Prospecting Company—(Sections 1919-87M., 2095-87M., 2096-87M., and 2173-87M. Visited 27th October, 1890.)

This Company must not be confounded with the Tasmanian Silver Mining Company, Limited, above mentioned. A large strong wide outcrop of magnetite of good quality runs in a north-westerly direction from Section 1642-87M., through 1830-87M. and 1919-87M. No work has been done for some time, and the old workings on the last-named section are now full of water and cannot be examined. Several small shafts and drives have been made towards the north end of the outcrop of magnetite. From the fragments of material lying on the surface it is evident that lode stuff, consisting mainly of quartz carrying pyrites and blende in large quantities was obtained from these workings, and I have also been shown fair samples of galena said to have been got from them. Even these, however, were much mixed with blende and pyrites. The load-matter from which the ore was obtained appears to lie on the south-west side of the magnetite lode. The country west of this is a highly matamorphosed slate, and a little further to the westward the granite of Mount Heemskirk comes in. I do not think it at all likely that the magnetite outcrop will prove to be the capping of a silver-bearing lode. The occurrence is a very interesting one from a geological point of view, and on that account I should like to see some sinking and driving done on it; but I very much fear that it will have no commercial value until some future day when iron ore can be profitably mined.

Comstock—(Section 712-87M. Visited 29th October, 1890.)

Work here has been confined to driving a tunnel to intersect the two lodes seen in the surface trenches. This is now in a distance of 580 feet. Bad luck was experienced in cutting No. 1 lode, in a spot where it was very large and very barren. The tunnel passed through crystalline dolomite, similar to the gangue of the lode in the surface workings, for 65 feet,—the rock containing a little talc, occasional strings and specks of galena, and some blende and pyrites. The walls are well defined, and there is also a large well polished slickenside in the middle of the mass. There can be little doubt that this really is the lode, and that it has been cut in one of the barren parts so common in all similar formations. It will now be necessary to drive along its course to the northward to get under the place where ore is known to exist in it. It is, however, the intention of the manager to push on the tunnel till No. 2 lode is cut, as the latter contains ore on surface almost above the tunnel. This lode should be almost at hand now. The country in the face is blue limestone, with white streaks, similar to that found alongside the lode in the large surface trench. Though this Company has been unfortunate in not striking ore in the lode at once, it should be remembered that the point where it is cut by the adit is a long way from the place where the good ore was got on surface, and there is no need to despair of ultimate success. I see no reason to alter my previously expressed opinion that this will be a good mine.

South Comstock—(Sections 803-87M. Visited 29th October, 1890).

Since my last visit to this property a very long prospecting trench has been cut up a small creek which runs down to the Comstock ground. A large mass of pyrites with some galena in it and some large loose pieces of good galena were obtained, but no defined lode. The country is much disturbed. There must be a lode somewhere in the vicinity, but further prospecting has to be done to find it.

Silver Queen Extended—(Sections 188-87M. and 187-87M. Visited 30th October, 1890).

In Section 188-87M. a tunnel has been driven 326 feet through rather hard slate country; it has to go 690 feet altogether in order to cut the first of a series of five or six parallel lodes that have been discovered in the creek running through the Section. Two of these are close together, not more than 20 feet apart; a short tunnel has been driven to cut these, and some surface trenching has been done on them in the bed of the creek. The first lode is from 4 to 5 feet wide, consisting chiefly of carbonate of iron carrying blende and galena, but not yet in payable quantity. The width of the second lode is rather indefinite; the country between the two is much impregnated with lode matter, so that it is probable that they will come together at no great depth: course N. 30° W. The main tunnel will strike these lodes about 100 feet below their outcrop in the creek, and, as the hills rise steeply on each side of the latter, a good height of backs should be available in them. Four other small lodes, running more or less north-west, exist higher up the creek about 11 chains from the eastern boundary of the section; nothing has yet been done on these, only their gossan outcrops having been noticed in the creek.

In section 187-87M. a great deal of prospecting has been done in the endeavour to pick up a continuation of the Silver Queen lode in Section 1638M.; the country is all the tufaceous rock above referred to. Just south of the south-east corner of 1638M. a tunnel 192 feet long has been driven due west nearly to the boundary of the Section; several small veins of ironstone were cut in this, one of which contained fine crystals of pyromorphite, which proved on assay to carry very little silver; this vein has a north-westerly course.

At a point about 420 feet west of the south-east corner of Section 1639M. and 56 feet south from the boundary line, a vein of somewhat siliceous black gossan was discovered, from 6 to 12 inches wide, running north-easterly; 20 feet east from this a shaft was sunk to a depth of 45 feet and a drive put in to the westward for 50 feet, which cut the vein again 24 feet from the shaft; nothing of value has yet been got from this vein, which in the drive from the bottom of the shaft is still as thoroughly oxidised as at surface. Going to the south-west the vein is found again in several trenches, now of much larger size, being from 6 to 9 feet wide. This is not unlikely to be the Queen lode; a new tunnel is to be started to cut it about 60 feet below where it is seen on the surface. It appears to be most necessary in this tufaceous country to get as low down on the lodes as is possible in order to have any chance of getting ore in them.

Sacramento—(Sections 1852-87M., 1287-87M., and 1288-87M. Visited 30th October, 1890.)

No one was working on these leases when I visited them; the only sign of work that I could see was one trench about three chains long near the boundary of the Silver Queen Extended and Sylvester Companies' Sections. A small vein, a few inches wide, of nice looking galena was cut in this trench, which is mostly through black slate.

Sylvester—(Sections 820-87M., 821-87M., 877-87M., 878-87M., 879-87M. Visited 30th October, 1890.)

Operations have been mostly confined to Section 820-87M. On this a lode running about N. 20° E. has been discovered, and traced by means of several trenches. The lode consists of clayey oxides of iron and manganese, and contains a good deal of pyromorphite poor in silver. Towards the south it appears to split into two branches, 2 ft. 6 in. and 5 feet wide respectively. Higher up the hill to the north it is about 6 feet wide. A shaft 14 feet deep has been sunk on it, but the lode soon dipped to the eastward and left it. Another small lode mostly of quartz, about one foot wide, is found running N. 20° W. a short distance west of the shaft. It should soon run into the first one. It is stained with oxides of iron and manganese, and contains a little pyrites. A tunnel is to be driven from the creek near the south boundary of the section on the main lode. As the outcrop rises rapidly up hill from the creek, this will test the lode to some depth.

Maxim—(Section 924-87M. Visited 1st November, 1890.)

Two lodes of carbonate of iron carrying galena are found near the centre of the section in very low swampy ground. One is about 18 inches wide, and strikes N. 35° W.; the other is 2 feet to 3 ft. 6 in. wide, and runs N. 20° W. The two should junction at no great distance from where they are laid bare. Some loose galena has also been found in black surface soil near the line of these lodes. There is not much galena in sight in them, but they are very promising, and well deserve a trial. Pumps will be required to sink on them. As previously mentioned, the supposed kaolin lode in the south of the section proved to be only a whitish vertical bed of tufaceous country.

Serpentine is found on the south boundary of this section, and I was told that it is also met with in Section 1148-87M. It carries a little galena on the faces of the joints, but nothing to speak of. Should the lode in Fowler's Section 547-87M. be indeed Balstrup's, it can hardly fail to pass through the north-east corner of the Maxim ground: it is worth looking for. The section has good prospects on the whole.

Percy Fowler's Section—(1055-87M. Visited 1st November, 1890.)

About 5 chains north and 3½ chains east from the N.W. corner of the Maxim section an outcrop of ironstone is found, under which a short tunnel has been driven, cutting a lode of carbonate of iron showing galena freely, though not in payable quantity. The thickness and course of the lode are not ascertainable till some more work has been done. Should it prove to be a north-westerly lode, it will probably be connected with the Maxim lodes. There is, however, another large outcrop of ironstone, carrying a little galena, in the side of the Manganese Creek, close to the north boundary of the section. Should this be part of the same lode as the first, its course would be about N. 40° E. This outcrop is, however, much in the position where Balstrup's lode might be expected to be found. It is evident that a lot of prospecting has yet to be done on this section to prove what it really possesses. It has a very good show, and deserves to be worked with vigour, instead of lying idle as at present.

Mount Dundas District.

In my former Report on this District I expressed the opinion that "a detailed examination of it twelve months hence would be quite soon enough to give an idea of its value." In this opinion I still remain, for so little has been done in opening up the lodes that there is in most cases little except surface indications to examine, and these, while giving good grounds for sanguine hopes as to the future of the mines, do not allow anything to be predicted of them with an approach to certainty. An immense number of outcrops of iron and manganese oxides have been discovered all over the field, but in only a few instances has work proceeded far enough to show what like the lodes underneath them are. When a good many more of these gossans have been sunk and driven through, evidence will be forthcoming to form a judgment of the probable value of the still unproved ones, but now any estimate is pure guesswork.

There is no reason to fear that good ore will not be found under the ironstone—rather is it likely that it will be; but every mining district has local peculiarities, and until something is known about these it is premature to be positive as to the behaviour of the lodes. During the next six months of dry weather, if work on the claims is carried on with energy, a good basis of facts will be laid on which a judgment can be founded with some confidence. The most important contributions to our knowledge of the Dundas lodes as yet have been derived from the tunnels of the Mount Dundas, Maestri Broken Hill, Comet, and Adelaide Proprietary Companies, to which we may add Balstrup's at Mount Zeehan, as it is a precisely similar occurrence. In all these instances tunnels have been driven into the lodes from low levels, very little above the probable water-level of the localities. In the Adelaide tunnel, and to a small extent in Balstrup's, unoxidised ore—viz., carbonate of iron and galena—has been found after getting well into the hills enclosing the lodes. In Maestri Broken Hill tunnel galena and cerussite were found, together with a little carbonate of iron, but the bulk of the lode stuff was thoroughly oxidised. The same was the case in the adjoining tunnel of the Comet Company, only that galena and carbonate of iron were not found above water-level, and carbonate of lead was not obtained till a winze had been sunk nearly to it. In the Mount Dundas Company's tunnel, though 200 or 250 feet below the outcrop on the top of the hill, the lode-stuff was found to be thoroughly oxidised. Chromate of lead in fine crystals was found, but no galena or even carbonate of lead. These instances would seem to show that many of the large gossan lodes may be expected to be thoroughly oxidised down to the water-level, and as it appears certain that one result of this is the leaching of the silver and lead contents from the oxidised portions, the latter may be expected to be almost barren

except near the water-level, where, however, it is very probable that they will be rich, the enrichment being the result of the deposition at water-level of the metallic contents dissolved from the oxidised upper parts of the lodes. The celebrated Broken Hill (N.S.W.) mines appear to be thus enriched, the gossan outcrop of the lode being as a rule poor in both lead and silver, while in the bottom the galena and sulphide ores found are also poorer than the intermediate rich zone of carbonate of lead and chloride of silver ores. Should it prove at Mount Dundas that the large lodes are thus oxidised down to water-level, most of the mining will have to be done from shafts, and the advantages of natural drainage will be lost. This thorough oxidation is more likely to take place in the case of large wide lodes than in that of narrow ones, the former offering greater facilities for the passage through them of the water which with its dissolved gases is the cause of their decomposition. Several instances can even now be seen in the field that show that the smaller lodes at any rate are not altogether changed to gossans. For example, high on the slope of the hill south of the Comet property a lode has been struck (in Section 2297-87M.) showing galena almost on the surface. When this is traced on to the top of the hill (in 1796-87M.) it is nothing but gossan without a trace of lead. This is at a height of 63 feet above the galena, which itself is 315 feet above the water-level shown by the adjacent workings of the Comet and Maestri Broken Hill Companies. It is clear that in this instance, though oxidation has begun in the lode, it has descended to no depth to speak of. The same will probably be the case with many other of the narrower lodes, and very likely with some of the wider ones as well, so that the exceptionally good facilities of the field for drainage by means of adits will not be thrown away, but be here, as elsewhere, a strong recommendation in its favour.

The Dundas field has been enormously extended of late, and is still widening day by day. Great numbers of the sections are not yet surveyed, and consequently nothing has been done to develop the lodes upon them. On most, therefore, the gossan outcrops are seen in their natural state, quite undisturbed, and any conclusions that may be drawn as to the value of the ground and the future of the mines must be deduced from their appearance alone. This is not enough to go upon, further than to warrant the spending of some money in sinking and driving to ascertain what lies beneath. Finding that this was the state of the field I did not attempt to visit one-tenth of the total number of sections, but contented myself with seeing such as had something done upon them, or as I could learn were best worth going to. The majority even of the surveyed sections had no one working upon them, and as there are very few tracks it is a matter of impossibility for a stranger to find the lodes, supposing him to be able to find the sections themselves to begin with. The dense bush covering everything makes this no easy matter. A great deal of track-cutting will have to be done before underground work can be begun. The Government track north from the Zeehan-Dundas road to the Pieman River will be an immense convenience to the district, and the sooner it is widened and formed into a road the better it will be for all concerned. I am not at all sure that a horse tramway would not be as cheaply made as a road, and it certainly would be more easily maintained, for some years at least. From the configuration of the country this must be the main road through the Dundas and Pieman River field, numerous branches connecting it with the mines. The difficulty of getting tools and supplies to the claims is retarding the development of the mines exceedingly, everything having to be carried in on men's backs at present. The labour of thus getting in such things as a blacksmith's forge, with its anvil, bellows, and grindstone, is so great as to be deferred till the last possible moment; yet no driving can be done without a forge for sharpening picks and drills. Combination among the owners of sections is greatly required in the work of cutting tracks. This should be set about without delay, so as to be finished before next winter. If not hurried on with there will be next to nothing done before wet weather is again set in, when progress will be both difficult and expensive to make. On the present summer's work it depends whether the field will be really opened in 1891, or left practically idle for another year or more.

Leaving Mount Zeehan on the 15th October, I went to the northern portion of the Dundas field first. This is most easily reached by going out through the Despatch, Silver Crown, and Western sections on to the open button-grass country, where a northerly course is followed for two or three miles to the edge of the bush. Through this a foot-track has been cut by Mr. Meredith, the original prospector of this northern part of the field. This is a fair foot-track, but requires to be made passable for packhorses before much work can be done on the claims. As it is the best way of getting to a large number of valuable sections, I would recommend that the widening and improvement of it be taken in hand by the Government. It is doubtful if the above-mentioned track northward to the Pieman River from the Zeehan-Dundas road will come near enough to these sections to be of much benefit to them. Having spent a day in looking at several discoveries in the north, I then came south-east and south through a number of sections not yet on any published chart of the district, though several of them have been surveyed, passing through Fletcher's, the Caledonian Company's, Renison Bell's, Robb and Webster's, Glock's, the Madam Melba Company's, and other sections to the North Dundas Company's Camp. From here I went to the Great Nevada property, and thence south along Moore's new track to the main road from Zeehan to Dundas, by which the centre of the Southern Dundas field was reached. It is rather a misnomer to call the northern portion of the field by the name of Mount Dundas, as it is on the basin of the Pieman River, and quite away from even the base of Mount Dundas. As sections are now being taken up on the north side of the river also, it might be well to call the whole of this the Pieman River Silver Field. The mineral belt appears to be running northward straight for the Heazlewood and Whyte River fields, and there seems every probability that it will extend right through.

As showing how entirely undeveloped the northern field yet is, I may say that between the Pieman River and the South Dundas field I saw only four places where there was any payable ore in sight. These will be mentioned presently when the various sections examined are described in detail. Large numbers of gossan lodes were, however, seen, and from their great size and length there can be little doubt that important discoveries will be made beneath the ironstone. Most of this yields two or three ounces of silver to the ton on assay, which gives promise of the improvement of the lodes in depth. I did not, however, see any lead minerals in these outcrops, except in the few cases above referred to where galena was in sight.

In these, carbonate and phosphate of lead were found in the ironstone close to the galena, but higher up the gossan was barren in them. This is favourable to the idea that good ore exists under the other gossan outcrops, for if we find that a lode which shows galena where cut through in the bed of a creek passes rapidly into barren gossan as we ascend the hills on each side, it is safe to expect that similarly barren gossans will have galena below them in depth in like manner.

There can be little doubt that the unoxidised gangue in the lodes below the ironstone caps will prove to be carbonate of iron, just as in lodes on the Zeehan field. This mineral has been struck under the gossan in the Adelaide Proprietary tunnel, and shows along with the galena in some of the northern sections. Another reason for predicting its occurrence in depth is that the ironstone outcrops frequently contain pseudomorphs of brown iron oxide after siderite, that is, crystals of brown iron ore which have the characteristic shape of carbonate of iron (siderite) cystals, and have been formed by the slow oxidation of the latter. Where they are visible it may be assumed that the oxidation of the outcrop does not descend to any considerable depth, and that carbonate of iron, and with it its close associate galena, will be found a short distance below the surface. I noticed this feature more commonly in the lodes of the Pieman River district than in those of South Dundas, and infer from it that the former will be found to be less oxidised in depth than the latter. Some of the prospectors call these pseudomorphs "tomahawk iron," from the resemblance of the crystals to the blade of an axe.

Reviewing the whole field, I do not think that there can be any question that we have here a very extensive and valuable mineral district. From the rugged and heavily timbered nature of the country it will necessarily be some time before the mines can be opened up so that an estimate can be formed of their ore-producing capabilities, and a still longer time before they are in a position to send steady supplies of ore to the furnaces. The great number of the lodes is itself against the rapid development of the ground, as the available capital becomes distributed in small amounts over a large number of mines, instead of being concentrated on a few of the best. This has the advantage, on the other hand, of leading to the prospecting of a greater number of the lodes, from which it will better be found what ones are best worth further expenditure. I may here take this opportunity of referring to a practice which is much too common, of floating companies with a large nominal capital, of which only perhaps £2000 or £3000 is available for working the mine. The promoters receive large interests in paid-up shares, and often considerable sums in cash besides. The amounts thus paid are usually quite out of proportion to the value of the mines as calculated on any sound basis of valuing. They are in fact such "fancy" prices as the high expectations of the promoters may excite them to ask, and the enthusiasm of the public for fashionable stock may tempt them to give. No matter how good a mine may be, if the owners cannot cannot bring it themselves into a paying condition, it is of little value to them. They must therefore be prepared to make sacrifices to attract the required capital. Where the future of the mine is a matter of speculation the price that should be paid for it ought really to be very small, as there is only a chance in a lottery to pay for. If the original holders of the ground are recouped for their time, trouble, and expenses in securing it, and get a large interest in anything of value that may be found, and further secure that enough money to open the mine properly is spent upon it, they receive all that any fair valuator can consider due to them as a price for it. If it turns out well they participate largely in the profits, if badly, they suffer no loss. There have been a few glaring instances of rapacity lately on the part of promoters of companies at Mount Dundas that lead me to draw attention to this matter. In the best interests of the district it is necessary to protest against the way in which the money that should go to working the mines is diverted into the pockets of these men. The field cannot get on without money being freely spent in working it, and cannot pay a penny in dividends till it is worked, and it is therefore absolutely essential that capital should go into the mines, and not be thrown away in buying out the rights of first holders. The public are greatly to blame in giving the high prices asked for, especially as they gererally do so on the exaggerated representations of the promoters themselves, and without any thought of the probable cost of bringing the mines into a paying condition. Perhaps the reiteration of the fact that very few of these properties can raise at the present time one hundredweight of payable ore, and that their value is entirely prospective and speculative, may help to impress upon the public mind the necessity of requiring that the bulk of the money subscribed should be spent on the ground in mining work. These remarks must not be construed to mean that there is nothing of any value at Mount Dundas—far from it. The indications and probabilities of the existence of great mineral wealth are extremely good, only it has to be mined for, and consequently money must be put into the ground. It is only by doing so that it can be ascertained which of the lodes are valuable, for among such a number it is in the nature of things that there should be many worthless. When the lodes have been proved to contain payable ore, it is quite time enough to pay large prices for interests in them. I have to take some trouble to say that I am not running down the Dundas field, for my last Report was construed by some writers in the public press into a condemnation of the whole of the West Coast districts, which it most certainly was not. If I do not extol its prospects to the extent that is often done, it is because it is good enough to stand on its merits without any such aid. There is much more to be feared from the evil results of "booming" the field than from a simple exposition of how matters stand. A "boom" is sure to be followed by a reaction and depression; and while anxious to see capital going into the mines, and believing that it will yield a good profit if properly applied, I should be very sorry to see the properties raised to absurd prices by the fever of speculation.

I shall now give a few notes on the sections visited. In a few instances the applications had not been surveyed, and it is within the bounds of possibility that in some of these the lodes will be found to come within the leases of previous applicants. The applications are often so close to each other that when the surveys are made there is no ground left for the later applicants.

Sections 2522-87M *and* 2523-87M. (Held in the name of Henry Gore. Visited 16th and 17th October, 1890.)

On these sections a very fine lode is exposed in a creek near the boundary line between them, in two places, about two chains apart. It has not been cut through so that its true thickness can be seen, and this is somewhat difficult to determine from the outcrop, as the lode dips easterly about 55°, and at the same time crosses the creek diagonally, so as to appear larger than it really is. As nearly as I could judge, it is from 10 to 12 feet wide. Course N. 15° to 17° W. The lode appears to be made up of several bands, the largest being from 3 to 4 feet thick. Splendid fine-grained galena is seen in thick bands in the exposed section, and payable ore could be at once knocked out. Some of this galena contains antimony, and gives very high assays, one of over 1800 ounces to the ton having been obtained from it. The gangue of the lode is quartz, siderite, and iron pyrites. This has every appearance of being a stong permanent lode. On the south side of the creek it can be traced up the hill to a height of about 63 feet, the outcrop changing into an ironstone gossan, with no lead ores showing in it. Close to the galena, however, pyromorphite and cerussite occur plentifully. As the creek falls rapidly, I do not think there would be any difficulty in getting a tunnel from it to cut the line of lode 50 or 60 feet below the outcrops of galena. A large quantity of ore could be obtained by driving on the course of the lode from where it is cut by the creek. This discovery gives excellent promise of making a good mine.

In another creek on Section 2522-87M, some 7 or 8 chains S.E. from the above, a lode formation 10 or 12 feet wide, and striking about N. 30° W., is found. Nothing has been done to prove this, but in all probability it is part of the same lode as the last-described. One seam 8 or 10 inches wide in it shows galena freely.

Section 2470-87M. (Held in the name of Henry Gore. Visited 16th October, 1890.)

Some 8 or 10 chains north from the centre of the southern boundary of this section there is a very large outcrop of iron and manganese oxides, with a good deal of quartz. The strike of the deposit is not yet determined. The gossan outcrop is close on 300 feet above the level of a creek close by it, so that the lode could be easily tested by an adit.

Sections 2471-87M *and* 2473-87M. (Held in the name of Henry Gore. Visited 16th October, 1890.)

About the centre of the boundary line between these two sections a lode about 5 feet thick has been found in a creek, consisting of siderite and carbonate of lime, with galena, blende, and iron pyrites disseminated through these. Course N. 10° W., dip westerly. In Section 2471-87M, what may be the same lode is again struck, but not exposed sufficiently to make out its course. Some nice loose galena was here obtained. So far these lodes are not payable, but deserve further examination.

Towards the centre of the same section a lode of carbonate of iron is cut, showing about one foot thick, and containing some galena. Course N. 65° W., dip towards N.E. This requires to be further stripped and trenched upon. The country here is limestone, itself carrying a little galena.

Sections 2492-87M *and* 2493-87M. (Held in the name of Henry Gore. Visited 16th October, 1890.)

At the western end of the boundary line between these sections, and on the east boundary of 2470-87M, a large strong outcrop of brown iron ore, 10 to 12 feet or more wide, has been found, containing numerous pseudomorphs of limonite after siderite ("tomahawk iron.") Course about N. 14° W. About 5 chains E. from the centre of the W. boundary of Section 2582-87M another ironstone outcrop is said to occur on the line of this lode, and another again in the centre of Section 2472-87M. I did not see these two outcrops, but can rely on the information as to their existence. The lode where I saw it appeared to be strong and well defined, and I should quite expect that it would extend into Sections 2582-87M and 2472-87M.

Section 2529-87M. (Held in the name of T. C. Fletcher. Visited 17th October, 1890.)

A huge outcrop of gossan is found in the centre of this section, and running to the S.E. from it through the middle of the two sections of the Caledonian Company, 2548-87M and 2578-87M. It is said to have been traced for nearly two miles. Course about N. 75° W. The gossan is composed of brown oxide of iron (with "tomahawk iron"), some oxide of manganese, and a good deal of quartz. This should be a very large lode, and ought to be tested without delay.

Section 2547-87M. (Held in the name of T. C. Fletcher. Visited 17th October, 1890.)

This section lies immediately to the south and south-east of 2529-87M. In the centre of it a large ironstone outcrop with a course N. 20° W. shows very clearly for about two chains. It is said to have been traced for more than a mile. The gossan consists, as usual, of iron and manganese oxides with quartz. No work has yet been done on it.

Sections 2956-87M *and* 2663-87M. (Held in the names of R. T. Moore and F. Burns respectively. Visited 17th October, 1890.)

In cutting the boundary line between the two sections, about 8 chains from the N.E. corner of Burns' section, a lode was discovered by the surveyors. It consists of about six feet in width of carbonate of iron and galena with a little oxide of iron, oxide of manganese, and carbonate of lead. A trench has been cut across it revealing galena in what is probably payable quantity. The course of the lode is not distinctly seen, but appears to be about N. 40° W. and with a north-easterly dip. From its position this might well prove to be part of Meredith's galena lode found in Sections 2522 and 2523-87M. The lode is in somewhat low ground, but probably 50 feet of backs could be obtained upon it without much length of an adit. It looks very well, and deserves early development.

Sections 2537-87M, 2536-87M, 2534-87M, *and* 2535-87M. (Visited 17th October, 1890.)

These sections were not surveyed when I saw them, and with several others were applied for by the Renison Bell Prospecting and Mining Company, No Liability. They extend in a south-easterly direction from east of Section 2578-87M of the Caledonian Company's previously mentioned. They have been taken up so that a large ironstone lode found on them will pass approximately through the centre of each section. The course of this lode is about N.N.W. The gossan in one of the sections forms a cliff quite 20 feet high, and is of great width. The lode-matter seems to be thoroughly oxodised to a great depth, for where it crosses a large creek it still shows as gossan without any lead minerals such as cerussite and pyromorphite. From this creek to the top of the hill towards the south end of the sections must be from 500 to 700 feet vertically. The lode can be easily tested by driving on its course from the place where it crosses the creek. From its great width and length this should prove a very important lode. The facilities for working it by adits are especially favourable.

Sections 2958-87M *and* 2959-87M. (Visited 18th October, 1890.)

The first of these two 80-acre sections is applied for by R. Webster and C. Robb, and the second by C. Robb. They were not surveyed when I visited them. They lie to the south and east of the Renison Bell's Co. sections just spoken of. A very large ironstone lode runs about N.W. and S.E. through these two sections, crossing the boundary between them at the centre of the line. The gossan consists of iron and manganese oxides, and in places cannot be less than three chains in width. The lode may be easily tested either by a drive on its course or by a crosscut. Its appearance is promising enough to call for a thorough trial. As a surface "show" it is quite equal to many of the best at South Dundas. The same might be said of the Renison Bell, Caledonian, and Fletcher's ironstone lodes.

Section 2566-87M. (Visited 18th October, 1890.)

This unsurveyed section is applied for by M. Glock. An ironstone lode, whose thickness I could not properly see, has been found in it, running through the centre of the section, about N.W. and S.E. The gossan is of a favourable nature. No work has been done to expose the lode.

Section 2567-87M. (Visited 18th October, 1890.)

R. Webster has applied for this section, also unsurveyed at the time of my visit. In a small creek on it a small gossan lode has been cut, said to be on the line of the above Glock's lode. The application notice is in the centre of the ground applied for, close to the place where the lode has been found.

Section 2595-87M. (Visited 18th October, 1890.)

This is in the name of W. M'Loughlin on the September chart of the Dundas District, but I understand that it, with several other adjoining ones, is held by the Madame Melba Company. The country rock in this vicinity is serpentine, thus differing from the sections previously described, which were all on slate and sandstone. About the centre of the section a fine lode has been cut in a small creek. It is 26 inches wide, and consists of almost solid antimonial lead ore (Jamesonite probably), with a little quartz, blende, and pyrites, and some blue calcite and green talc. Course N. 25° W., dip S.W. 80° to 83°. On the slope of the hill, north of the creek, it has been cut again 2 feet 6 inches wide, but composed entirely of iron and manganese oxides, with a little quartz. Though this lode is small, it is almost solid ore where cut in the creek; and if this continues for any distanee it is quite large enough to give handsome returns to the owners. A tunnel can be driven from lower down the creek to cut the lode at a considerable distance below the outcrop. I unfortunately arrived on this section just after all the men working on it had left to go to the township, and consequently I was unable to find another lode that exists on the property. The antimonial lead lode, however, is of itself good enough to stamp the section as a valuable one.

Section 2629-87M. (Held in the name of W. M'Loughlin. Visited 18th October, 1890.)

On the centre of the north boundary of this section some loose gossan may be seen, and there is an outcrop of decomposed serpentine rock that looks something like a lode. I could not ascertain if this had been mistaken for a lode, or if anything else had been found on the section.

North Dundas Company—(Section 2306-87M. Visited 19th October, 1890.)

This section is on the lode described in my former report as Webster and Bennett's. A tunnel has been driven on the course of the lode for 108 feet, running S. 28° E. The lode-gossan is seen on the hill above the tunnel, and again below it; but where the drive has gone in, the lode must either have been thrown to one side of its average course, or else been filled by a large "horse" of country, as the drive has not been successfal in finding it. One small crosscut, 15 feet long, was put in at 86 feet from the entrance without touching any lode-matter. It is intended to drive 150 feet, where the adit would be vertically below the outcrop of the lode on the surface, and, if the lode is not then cut, to crosscut the country until it is found. It cannot be far distant, and it is only a question of a short time till it is picked up. The adit is 250 feet below the crown of the hill, and another level 250 feet lower could also be got on the course of the lode, the nature of the country being very favourable for working by adits. It is very unfortunate that this Company should have had difficulty in finding the lode at the point they selected for driving on, as it is one of the typical gossan lodes of the district, and its behaviour in depth will be a great guide as to what to expect in other similar cases. Should it prove, for example, to be entirely oxidised at the level of the present adit it would be well, in Fletcher's and Renison Bell's big lodes, not to drive at a high level at all, but to test them at as near water-level as an adit can be obtained. On the contrary, should lead ores be found in this tunnel, there would be great hope of getting them also in the higher portions of other gossan lodes.

This lode is now said to have been traced through five sections, from 2364-87M on the north, through 2316-87M, 2306-87M, and 2305-87M, to 2304-87M on the south. A large outcrop of iron oxide in the N.W. corner of 2237-87M may also be part of it. Meredith's ironstone lode, running from Section 2470-87M to 2472-87M, and the galena lode running from Section 2523-87M to 2663-87M, are both approximately on the line of this big lode, and may, perhaps, prove to be connected with it. The lodes seem to have a general north-westerly course, more or less parallel to this line, all through the Pieman River portion of the Dundas field.

Great Nevada—(Sections 2456-87M, 2394-87M, and 2393-87M. Visited 19th October, 1890.)

A strong well-defined outcrop of iron and manganese oxides, with a great deal of quartz, is found running N. 50° E. for about 12 chains through the middle of Section 2394-87M and the north-west corner of 2393-87M. A small portion of it passes through the S.E. corner of 2654-87M.

The ground is rather low-lying on the whole, and the lode will probably have to be worked from a shaft. A tunnel is being put in to test the lode, but has as yet got nothing but thoroughly oxidised ore, and I fear that sinking will have to be done before any payable ore will be met with. The tunnel was only 48 feet in length at the time of my visit, 23 feet being through the lode, which, however, was not yet cut through, and must therefore be even wider than this. The quantity of quartz in the gossan makes me rather doubtful of its probable richness in lead and silver in depth, as quartz does not decompose, and may be expected to be found in depth in equally large proportion as in the outcrop. The lode is a strong one, however, and deserves to be prospected.

Comet—(Sections 1794-87M and 1796-87M. Visited 20th October, 1890.)

This property has deservedly attracted a large share of public attention, not only on account of its proximity to the rich discovery of galena and cerussite ore in the adjoining Maestri Broken Hill mine, but also from the number of lodes occurring in it, and the facilities for working them by means of adits. The principal workings are on Maestri's lode in the N.E. corner of Section 1796-87M. Beginning at a point about 4½ chains south of the north boundary and one chain west of the east boundary of the section, a tunnel has been driven to the north about 295 feet. Taking the bearings of the tunnel with an ordinary hand compass, I found that the course was N. 50° W. for 216 feet, then N. 17° E. for 79 feet. This brings the end of the tunnel on to the north boundary of Section 1796-87M. The whole of the tunnel is through somewhat clayey oxide of iron and oxide of manganese, except about 22 feet at the inner end, where a soft breccia of angular slate fragments is met with, apparently forming the footwall of the lode. If this point is joined to the point in Maestri's tunnel where the footwall of the lode is met with, the course of the lode is found to be N. 68° W., which I believe is not far from the truth. I am surprised that the Comet and Maestri Broken Hill Companies should be content to remain so much in the dark as to such a very important thing as the true course of their lode. It is quite worth the expense of driving to the boundary in each mine along the footwall. It is not even yet quite certain that both mines are on the same lode, though I think that there can be very little doubt that this is the case. As both adits are in gossan ore from the mouth, it is clear that the lode cannot be less than 4 chains in width, measured on a horizontal plane. If the apparent dip of 35° seen in the footwall in Maestri's tunnel is anything like the true dip of the lode, its thickness must be about 150 feet measured at right angles to the walls.

At 29 feet back from the end of the adit a winze 18 feet deep has been sunk on the lode, and two drives have been made from it, one S. 70° E. 12 feet, and the other N. 12° E. about 14 feet. The last 6 feet of the latter was in the breccia met with in the adit everhead. In sinking the winze, crystals of carbonate of lead soon began to appear, and became more and more plentiful as it went down, till in the bottom really good ore was obtained. In the two drives from the bottom of the winze cerussite crystals occur very freely, together with yellow oxide of lead, locally known as "canary ore." The ore appears to be improving every foot it is sunk upon, and there can be little doubt that even better ore is under foot. Unfortunately, water became troublesome, and the winze could not be sunk deeper. The adit is only a few feet above the level of the creek which traverses the Maestri Broken Hill and Comet properties. In order to strike the lode at a lower level, the manager has determined to drive from another gully in Section 1794-87M. This work was just begun at the time of my visit. The drive will strike the lode only 40 feet below the first adit, or 22 feet below the bottom of the winze. It is believed by the mining manager that the lode will be struck in 360 feet of driving, but this is on the supposition that the course of the lode is about N. 27° W. Should it prove to be, as I incline to believe, N. 68° W., the distance to be driven will be over 500 feet. Under the present circumstances of impossibility of getting pumping engines on to the ground, the policy of driving this adit at so small a depth below the first one is, in my opinion, quite justifiable, especially as it will prospect a good deal of ground and settle the question of the course of the lode. Both this and the Maestri Broken Hill Mine will, however, ere long require to be worked from shafts equipped with good pumping machinery.

The Maestri Broken Hill Company's eastern lode, running about N. 30° W. has been found cropping out, has an ironstone gossan on Section 1794-87M, but nothing has yet been done to test it.

In the south section the ground rises very rapidly into a steep hill 486 feet in height above the level of the creek at the tunnel mouth. The southern boundary of the section lies along the ridge of the hill. The lode in Kozminsky's Section 2297-87M, which I described as Lambie and Davis's in my former Report, has been traced into the Comet ground, several trenches having been dug upon it. In one of these it is seen as a gossan of iron oxide 27 feet wide, and a pit has been sunk upon it about 10 feet without coming to any unoxidised ore or lead minerals. This is about 63 feet higher up the hill than where galena is seen in the lode on Kozminsky's section. The course of the lode appears to be about N. 35° W. Going west-

SILVER SECTIONS

MOUNT DUNDAS

SCALE. THIRTY CHAINS TO AN INCH

OFFICE OF MINES HOBART MARCH 1891

Osmund J. Roper draftsman

Within dotted lines thrown open to selection under 49 sec: Crown Lands Act 1890, reserving mining rights

Course of Tides shown hereon are charted approximately only not being from actual survey

TOWN OF ZEEHAN

PIEMAN RIV:

DUNDAS TO ZEEHAN RAILWAY

PROPOSED RAILWAY

SCOTTS TRACK

LITTLE HENTY RIVER

SECOND LITTLE HENTY

THIRD LITTLE HENTY

100 Ac. RESERVE FOR LIME

Climie's line

SILVER SECTIONS
MOUNT ZEEHAN

SCALE. THIRTY CHAINS TO AN INCH

O. J. Roper draftsman

Within dotted lines thrown open to selection under 49 sec: Crown Lands Act 1890. reserving mining rights

Course of Lodes shown hereon are charted approximately only not being from actual survey

OFFICE OF MINES. HOBART
MARCH 1891

ward along the south boundary of 1796-87M another lode is struck, 126 feet lower than the above trench. Here there is a small lode of galena and carbonate of iron, running about N. 30° W., about 2 feet wide. This continues south into Kozminsky's section, and has been bared for about two chains in a surface trench. It is in the valley of a small creek, and could be worked by an adit driven from a point some distance down this. Both these lodes are well worth testing. The upper one has been proved to contain galena over 300 feet above the water-level.

Maestri Broken Hill—(Sections 2356-87M and 2355-87M. Visited 23rd October, 1890).

This mine has at present the best show of ore on the field. The workings are in the S.W. portion of Section 2356-87M, close to the boundary of the Comet ground. About a chain east of this boundary carbonate of lead was found in the large creek passing along the south of the sections. Somewhat soft iron and manganese oxide gossan being found cropping out on the north side of the creek, a tunnel was driven into it in a direction N. 12° E. This almost at once struck rich cerussite and galena ore, which continued to be found in large quantities through the iron and manganese oxides that form the bulk of the lode, for about 120 feet. At 120 feet from the mouth of the drive a band of carbonate of iron striking N. 25° W. was encountered. After passing through this the drive continued in iron and manganese oxides to 206 feet without coming upon any more lead ore. The gossan ore in this portion of the tunnel is arranged in bands running about E. and W. At 206 feet the footwall of the lode was struck, also running east and west, and dipping southerly at an angle of 35°. The country rock from here onwards was brown slate and sandstone, much stained with oxide of iron, and much broken by joints, so as to have a somewhat rubbly character. Occasional crystals of cerussise and pyromorphite and some talc were found through this country. At 447 feet the course of the drive was changed to N. 35° E, so as to go more directly towards the eastern lode seen on surface. About 70 feet had been driven on this new course at the time of my visit. At about 482 feet a vein of manganic ironstone, 1 foot 6 inches wide, was cut through, running N. 55° W. The drive is to be continued to cut No. 2 lode, which ought not now to be far distant.

The ore in the first part of the adit seems to run obliquely across the lode, supposing the course of the latter to be E. and W. as shown by the footwall, or N. 68° W., as calculated from the evidence of this and the Comet mine. At 55 feet from the mouth of the drive a course of ore from 6 to 7 feet wide, carrying galena in bands up to a foot and more in thickness, was passed through, running N. 2° W., and dipping to the west. Another course of excellent galena ore in the mouth of the drive runs obliquely across it also a little to the west of north. Taking the run of these galena bands with that of the carbonate of iron band cut at 120 feet, I think that it will be found that there is a shoot of ore crossing the lode obliquely in a north north-westerly direction. This would agree with the discovery of ore in the Comet winze, which is on the northern side of the lode, whereas Maestri's find is on the southern side. A line running N.N.W. from Maestri's winze would not go far from the Comet winze. Should this theory prove correct, it will be likely that other shoots of ore will in the same way be found to lie obliquely across the main lode mass. A supposition suggests itself that the ore belongs to a north-westerly lode running through the large east-and-west one. This is possible, and will be tested by the new adit in the Comet ground.

A winze has been sunk 25 feet in from the mouth of the adit to a depth of 21 feet, but, as water began to collect, two drives were opened out at 16 feet eastward and westward, on a course N. 75° W. The east drive was 9 feet clear of the winze when I saw it, and the west drive 15 feet. The latter was in splendid cerussite ore, with a good deal of galena and sulphate of lead. The eastern drive was not so rich, though still very good. The lode in the winze and these drives is very rich. The manager estimates that he has obtained 40 tons of first-class galena, 8 tons of good mixed galena and cerussite, and 70 tons of cerussite ore from all the workings. No bulk assay has been made, but numerous small parcels assayed have all given rich returns of silver. It may be seen without assay that the ore is rich in lead, and the assays give every reason to believe that it has a high silver content. The owners of this mine have been fortunate in striking this rich bunch of ore right at the outset of their mining operations. Even though the shoot should prove to be of limited extent, which the find in the Comet renders unlikely, there is good ore enough now in sight to pay for machinery to sink on the lode to a depth of 200 or 300 feet.

Part of the difficulty of ascertaining the course of the Maestri's and Comet lode lies in the fact that the outcrop cannot be traced any distance on surface with any certainty, as the ground soon becomes covered with loose gossan from the outcrop of No. 2 lode, lying higher up the spur. This is a very large outcrop of iron and manganese oxides, covering in places two or three chains in which, running north-westerly across the top of the bridge under which the adit is driven. Pyromorphite has been found in the ironstone in places, but in no quantity; one or two shallow trenches have been dug on it, but nothing further. The extension of the main adit should soon reach this lode. Should it contain payable ore the value of the mine will be immensely enhanced, as it is a very large lode, and there is likely to be a much greater length of it in the sections than of the No. 1 lode. From the difference in their courses these two lodes ought to run into one another.

The manager of the company informed me that there was a third lode known to exist on the leases held, on section 2355-87M, showing siderite, quartz, iron and manganese oxides, blende, pyrites, and a little galena. I had not an opportunity of visiting this lode, which has not yet been prospected to any extent.

Kozminsky's Sections—(2297-87M, 2332-87M, and 2333-87M. Visited 20th October, 1890.)

Nothing was being done on this ground at the time of this visit, and so far as I could learn nothing of consequence had been done on it since my former visit. On this occasion I again looked at the two lodes in the north-east of Section 2297-87M, but found that nothing new had been done. The bulk of the lode-matter in both lodes is carbonate of iron. In the large eastern lode there is not so much galena showing now as formerly, as the prominent pieces have been picked out, and the whole exposure has become discoloured and dirty. The tracing of this lode into the Comet section has shown that its course is about N. 35° W. It is too good to be neglected as it has been, but as a company has been recently floated to acquire these sections, it may be hoped that work will now be vigorously carried on.

The large gossan lode in the north-west corner of Section 2297-87M, which I formerly described as showing crystals of chromate of lead, has been traced south-west through the south-east corner of 1851-87M, and thus appears to have a N.E. and S.W. course.

Talune Company—(Sections 2379-87M and 2380-87M. Visited 20th October, 1890).

At the extreme S.W. corner of Section 2379-87M ironstone gossan is found freely, and a lode most likely exists in the near neighbourhood.

The work on the leases at the time of my visit was confined to driving a tunnel on the north section (2380-87M), not far from the middle of it. This drive is being put in to the eastward from the side of a creek to cut two gossan lodes found higher up on the hillside. One of these, which should be struck in about 50 feet of driving, is a little over three feet wide in the outcrop, and runs about N. 5° W. The second outcrop has only been touched, not even cut through by a trench, so that its course and thickness are still unknown. A third small gossan lode, about two feet wide, was cut almost at the mouth of the drive. About a chain and a half down the creek from the tunnel yet another gossan outcrop has been found. The manager is waiting for drier weather before cutting through this by a trench in the bed of the creek. Nothing can just now be said as to its size or course.

On the hill to the west of the tunnel and across the creek from it, a more promising outcrop than any of the above is found, but has not yet been touched at all. It appears to run N. 5° E, but this is not very certain, as there is a lot of loose gossan lying about, and there is no guarantee that the two outcrops from which the course was taken are parts of the solid lode, or only large loose blocks. An adit from near the creek, about 180 feet long, should cut this lode at a depth of about 100 feet, as the hill rises very steeply. This outcrop is a much larger and more likely one than those that are now being driven upon, but all require prospecting. Nothing but gossan has yet been found on this section, though the number of lodes and their character give good hope that valuable ores will be found in time.

On the southern section, however, 2379-87M, galena has been obtained in low ground by the side of a large creek passing through the holding. The galena is in large cubical pieces, unlike the general character of the galena in other parts of the field, which is rather fine-grained. The lode appears to run about N. 80° E., and consists of 3½ feet of soft earthy manganese and iron oxides, with a vein of quartz from 8 to 12 inches thick, carrying a little iron and copper pyrites. No galena could be seen in the lode when I visited it, though numerous pieces of it were lying all round, so I presume the galena vein must have been covered up by the loose *débris* which has accumulated on the floor of the small cutting that has been made. A small vein running N. 40° E. has been trenched on each side of the creek, and a few pieces of galena appear to have been got from it. Nothing can be done here except in fine weather or by getting machinery to drain the workings. Efforts should be made in the dry weather to trace the lode further away from the creek. The trenching that has been done seems to me to have been off the main line of lode and only on a branch vein.

Adelaide Proprietary—(Section 2302-87M. Visited 21st October, 1890).

This section is remarkable for the great development of ironstone outcrops upon it, there being three large strong lines of them converging to a point about six chains from the north-east corner of the section on the northern boundary. About a chain to the north of this point, in Section 2303-87M, galena and native silver were found in the outcrop of one of the lodes in a creek. The Adelaide Company, having obtained an easement, began to drive on the course of this lode from a point in 2303-87M, about 30 feet north of their own boundary. The course of the drive is about S. 15° W., and it had been driven about 60 feet when I saw it. The outcrop of the lode stands up as a high ridge of ironstone immediately above the tunnel, and may be traced to the top of the steep hill lying south of it, and over into the next valley. It often forms a wall from 12 to 15 feet in height, composed of oxides of iron and manganese, with some quartz: course, N. 15° W. To the west of this lode another one is found on the side of the same hill, also standing out as a bold outcrop, and having a course N. 30° E., which should make it join with the first one about where the tunnel strikes it. This outcrop consists of oxide of iron, often in reniform fibrous shapes, oxide of manganese, and a good deal of quartz. It is very large, quite 30 feet wide in several places. The third lode is seen in the side of the creek, forming steep cliffs 20 to 30 feet high, about four chains S.W. from the tunnel, and running to meet the other two lodes about where they junction. The outcrop of this lode may be seen for quite two chains along the creek. It consists of oxides of iron and manganese, with but little quartz, and is soft in places, and full of small caves. All these lodes have a very promising appearance, especially the first and third. I understand it is intended to crosscut from the main adit to test the second one above mentioned.

The tunnel passed through soft gossan containing some chromate of lead for 36 feet, and then struck bands of carbonate of iron separated by partings of oxide of iron, and mostly carrying a little galena and blende, together with a few quartz bands. A little fairly good galena was occasionally found between the various bands, and some phosphate of lead was also got in the cellular quartz. All the bands appear to be lying about E.N.E. and W.S.W., which is nearly square across the line of lode as seen on surface. This may be due to the junction of one of the other lodes—the third one possibly, as it has about the same course as these bands; or, as in Maestri Broken Hill mine above described, the shoots of ore may lie across the lode at an angle to its course. So far no payable ore had been got in the workings when I visited them, but I have little doubt that it will soon be found, and that this will prove a good mine. It is encouraging to find galena in it so high above the water-level, as it gives hope that it may be worked by adits for a long time before sinking becomes necessary.

Anderson Proprietary—(Section 2303-87M.)

It was on this section that native silver was found in the outcrop of the first lode of the Adelaide Company's. A manager had been appointed, but had only arrived on the ground on the day when I was at the Adelaide, and as he said that nothing had been done on the section, and that he was only going to begin prospecting it, I did not go over it. The Adelaide lode ought to go right through this ground, and if found on the north side of the creek may be easily proved by a drive along its course. The country north of the creek is mostly serpentine.

Sections 2354-87M—(*Dundas Extended*) *and* 2336-87M (*Devonport*) were in much the same case as the last. Managers had just arrived to begin prospecting the claims, so I did not think it worth while to go to them at the present. The original prospectors could not be got hold of to show what had been found, and without a guide it is quite labour lost to hunt for the lodes.

Bonanza—(Section 2317-87M. Visited 21st October, 1890.)

On this section a tunnel is being driven to cut a lode which crops out strongly on the slope of a high hill. This outcrop is mainly of hard clayey and siliceous oxide of iron. The tunnel had been driven 40 feet when I visited the ground, and the lode was expected to be cut very shortly. The country passed through was brown clay with veins and nodules of brown iron ore. This tunnel is about 207 feet below the top of the ridge. About 54 feet lower down another tunnel had been commenced from the side of a small creek. This was driven some 20 feet or so through the same sort of country as the upper one, but had been discontinued until the upper one should have struck the lode and ascertained its position better. There are two ironstone lodes in the south-east portion of the section, and they should join one another near where the tunnel should strike them. I did not care for the appearance of these outcrops much, as they were very clayey and siliceous, instead of being mostly iron and manganese oxides. From this I infer that the lodes in depth will consist principally of clay and quartz, instead of carbonate of iron, which up till now has been the constant concomitant of the galena wherever found throughout both the Zeehan and Dundas Districts.

In a small creek running south through the section, however, very good-looking loose gossan is found in great quantity. This is probably from Kozminsky's chromate of lead lode, which has been traced S.W. from Section 2297-87M through the S.E. corner of 1851-87M, about to the boundary of the Bonanza section. The manager has begun to trench in two or three places to pick up the outcrop of this lode, which ought almost certainly to be soon found.

Very pretty green serpentine is found on the north boundary of this property. It is, unfortunately, much cracked and jointed; but on being cut into it is very likely that stone fit for lapidaries' purposes may be obtained.

Mount Dundas Company.—(Sections 1708-87M, and 1724-87M. Visited 23rd October, 1890.)

Two very large wide outcrops of iron and manganese gossan are found in Section 1724-87M. A tunnel has been driven, beginning at a point in Section 1708-87M about 600 feet west of the centre of its eastern boundary, on a course of S. 70° E., to prove the ground at a depth of about 250 feet below the crown of the hill on which the more westerly lode crops out. The mouth of the tunnel is in hard black slate, very much contorted. After passing through 322 feet of this, a lode was struck, running about fair across the drive, or N. 20° E., and dipping easterly about 1 in 1, composed of white rubbly cellular quartz, with very little oxide of iron stain. There is an outcrop of quartz on the surface corresponding to this lode, mentioned in my former report on this district. The drive continued to pass through it for 61 feet, when the hanging wall was reached. The country now met with was rather decomposed serpentine, so that this quartz lode appears to be of the "contract lode" character, interposed between slate and serpentine. The serpentine country was cut through till a point 451 feet from the mouth of the tunnel had been reached, and here the footwall of the gossan lode seen on top of the hill was struck. This lode is of very large size in the adit as well as on surface, for it has now been driven across a distance of 179 feet without coming to the hanging-wall. The course of the footwall in the adit is N. 10° to 12° W., and its dip slightly to the east. The lode-stuff varies a good deal. The footwall portion is very flinty, but the bulk of the lode rather soft and clayey. It contains a great deal of cellular and flinty friable quartz, and is more or less stained with oxide of iron, though this is not in any large quantity. On the surface the gossan is very clayey and full of quartz also, but is harder and contains more oxide of iron than in the drive. It is not at all like the iron and manganese gossan found on Maestri's and the Adelaide lodes. From its nature on surface and in the adit I expect that the lode will continue to be very siliceous in depth, and will not contain much carbonate of iron. In the adit the lode-stuff appears to be thoroughly oxidised, and from its porous nature it is probable that it will continue so down to the water-level. If the lode contains lead and silver in any quantity, they will probably be found close to and below this level. The only sign of valuable metals yet found is at from 460 to 476 feet from the tunnel mouth, where a good deal of chromate of lead has been discovered. This shoot of chromate ore appears to be widening as it goes down, being only about 10 feet wide in the roof of the drive, while 20 feet wide in the floor. A winze is being sunk upon it. I look upon this ore as a good indication of better ore being found in depth.

The other gossan lode seen on surface has not yet been tested in depth. It appears to me to be of a rather more promising nature than the first one, the gossan being less siliceous and containing more oxide of manganese. I confess, however, that this preference of the iron and manganese gossan to the clayey and siliceous lodestone may be only a prejudice, as the knowledge yet gained of the anatomy of the Mount Dundas lodes is much too limited to allow any conclusion, favourable or unfavourable, to be safely drawn on the point. It may prove that quartz is a better gangue for bearing lead and silver than the carbonate of iron. (These remarks will also apply to what has been said of the Great Nevada and Bonanza lodes.)

In a lode of the great size of that cut in the adit, it is most probable that the ore exists in patches and shoots, and further prospecting may yet find a Bonanza in it. The discovery of the chromate shoot shows that there is lead ore in the lode, and gives hope of better ores being found below. The further development of this mine will be watched with great interest by all who have anything to do with the field.

Maestri Silver Prospecting and Mining Association—(Section 2549-87M. Visited 24th October, 1890.)

Near the N.W. corner of the section some work has been done close beside a creek which here falls about 60 feet very rapidly in a succession of small waterfalls; consequently an adit could be driven under very favourable circumstances. In this creek several veins of solid white quartz up to three feet thick are seen. These, however, do not appear to be regular reefs, but rather what miners call "country quartz"—that is to say, irregular veins and bunches of no considerable extent. Near one of these veins a few crystals of galena and blende have been found in the joints and cleavage planes of the schist country rock, but as far as I could see there was no sign of the existence of a lode. A dyke of greenstone about 8 feet wide is found near here, and it is likely that the formation of the quartz bunches and the deposition of the minerals were due to its intrusion. The rock in which the galena was found is undoubtedly the country rock, not lode stuff at all. The occurrence of minerals in fractures in country rock is very common, and no significance can be attached to it.

About seven chains from the south boundary, and one chain from the western one, two trenches have been cut on a steep hillside. Some rather indefinite veins of quartz and gossan have been found in them. The quartz and a silicified schist associated with it carry iron pyrites and a little siderite. The veins are small and do not give much promise of permanence. Some assays are said to have been obtained from them of about 4½ ounces of silver to the ton however, and as they may come together and make it into a better lode in depth, some more prospecting might well be done on them. I do not, however, think that present appearances warrant the driving of a tunnel 300 feet long as is proposed. The outcrops might, with advantage, be cut into a little more deeply on surface so as better to expose the lodes. I have very little hope of the success of any operations upon them.

General Remarks.

As far as I could learn there was very little more to see on the field on the Sections not visited than quite undeveloped outcrops of gossan; mining work is only beginning on many of them. The character of the Dundas field can be fairly gathered from the description of the above selection of the Sections. I have no doubt at all as to its ultimate success; that is as assured as any mining district's future can be. If worked in a legitimate manner, and not for speculative purposes, its development should be rapid. The field has several advantages to compensate for the difficulties in opening it up; it has good timber, good water, and great facilities for drainage by adits. Where ordinary tramways could not be constructed there are few places where a short wire rope tramway would not connect the mines with practicable routes for them. Aerial tramways are not in common use in this Colony as yet, but I expect that they will be found very useful at Dundas. I do not like to speak positively as to the possibilities of getting water-power on the field, as I saw it when the streams were all full, after a longish wet season, but I should think that it is quite possible to get a supply of water for power from some of the larger creeks without much difficulty. In the deep valleys in which they lie it is very improbable that there are not many places where reservoirs might be constructed at a low cost. Should water-power be available electric energy might be utilised in a great many ways with great advantage. The use of electricity in modern mining is increasing very rapidly, especially in the United States of America. There is one source of energy that might be utilised for the South Dundas field at any rate, in the Big Henty River. It is not too far to bring electric power from this, and the water supply is a never-failing one. For the northern field there is plenty of power to be utilised in the numerous large affluents of the Pieman River.

In concluding my report of the state of the Dundas field, I have to acknowledge my gratitude to the various gentlemen who took so much trouble to show me over the properties, for the courtesy and kindness which they have showed to me. I am especially indebted to Mr. Charles Robb, who gave up four days of his time to guide me from Mr. Meredith's camp, near the Pieman River, to the South Dundas field. Without his assistance I should not have been able to find my way through the northern field.

COAL MEASURES AT THE HENTY RIVER.

On my return to Strahan from Dundas and Zeehan I made a discovery which may have a great influence on the future of these fields. Messrs. Jones and Bethune having applied for a lease of some ground for limestone, to be used as flux, wished me to look at it, especially as the limestone was full of fossils. The limestone was found in a creek running into the Big Henty River, on the north side, a short distance above the railway bridge. On making an examination I found that there was a considerable extent of ground along the railway line, just north of the bridge, occupied by a coarse white grit or sandstone. I was not able to define the boundaries of this formation, but it must be over two or three miles long and quite a mile in width. The creek in which the limestone was found has cut through this sandstone, affording a section of the strata about 200 feet deep. The stream falls very rapidly, there being about five small waterfalls from 8 to 30 feet in height in the space of about half a mile. The strata appear to lie almost horizontal, and to be very little disturbed. Below the gritty sandstone I found beds of fossiliferous sandstone containing species of *Spirifera*, *Productus*, and *Fenestella*. Going down the creek these sandstone beds were found to alternate with beds of mudstone and impure limestone, containing the same sort of fossils. The limestone is as a rule much too impure to be used as a flux; it contains a great many pebbles which would increase the per-centage of silica in it to far too high an amount. Some of it would probably burn to a fair hydraulic lime or cement, as it appears to be somewhat argillaceous. Below the lowest limestone beds come others of black shale or slate, with but few fossils; and beneath these, again, at a height of only about eighteen feet above

the level of the Henty River at the bridge, I found black shale very full of impressions of ferns characteristic of our lower coal measures, belonging to the genera *Glossopteris*, *Gangamopteris*, and *Nœggerathiopsis*. These were the lowest beds seen, for immediately below them down the creek I found clays containing leaves of a Tertiary type, doubtless belonging to the series of Tertiary leaf-beds surrounding Macquarie Harbour. These must rest against an escarpment of the coal-measure rocks. The discovery of the *Glossopteris* shales under the limestones is the point of importance in this section, as the same succession occurs in the Mersey and Don coal-field; and there the coal seams are closely associated with similar *Glossopteris* shales. It is not unlikely that there may be coal at the Henty also underneath them. The probability of this being the case is quite sufficient to warrant testing the measures with one or more diamond drill bore-holes. The first one of these would be well located just where the shales were found, the place being easy of access, and well supplied with wood and water. Should coal be proved to exist, its proximity to the railway from Strahan to Mount Zeehan would render even a small seam valuable. The coal seams, if any, will probably be found to extend under all the gritty sandstone seen on surface; and there is enough of this visible to show that there would be a considerable field. The country has not yet been explored to determine the probable size of this; but the finding of carboniferous fossils at Bell's and Hall's, at Mount Zeehan, makes it probable that the area is greater than might be suspected. We cannot tell, either, that the coal measures do not extend under the Macquarie Harbour leaf-beds, which occupy the flat ground between the Henty River and Strahan. The benefit to be got from the discovery of coal in this locality is so great that a much more remote chance of finding it would be worth trying. There may be no coal at all, or only thin worthless seams; but, on the the other hand, there is a good chance of finding a payable seam. I hope to hear of the ground being soon tested.

Near the Henty Ferry there is a bed of clay lying underneath the drifted sand-dunes. This appears to the eye to be of good quality, and may be very useful to make into bricks for the furnaces at Strahan and Mount Zeehan, and I therefore draw attention to it.

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

A. MONTGOMERY, *M.A.*, *Geological Surveyor.*

To the Secretary of Mines, Hobart.

REPORT ON THE GEOLOGICAL STRUCTURE OF THE BEACONSFIELD GOLDFIELD.

Geological Surveyor's Office,
Launceston, 10th July, 1891.

SIR,

I HAVE the honor to report to you the results of my geological examination of the Beaconsfield District.

Maps.—In order to illustrate and render the report more intelligible, there are sent herewith the following maps:—Plan No. 1, a plan of the Beaconsfield Goldfield, showing the position of the principal mine workings and the strata in which they occur; Plan No. 2, a plan of the Tasmania mine and enclosing strata, the latter being shown on the horizontal plane of the main adit; Plan No. 3, a similar plan of the underground workings of the Little Wonder, Moonlight, and Amalgamated West Tasmania mines, and a section across the Cabbage-tree Hill, showing the order of superposition of the strata. These maps are compiled from the official maps of the sections held under lease and otherwise in the district, the plans of the underground workings of the mines furnished by the owners annually to the Inspector of Mines, and my own surveys. Mr. G. T. Eddie's valuable maps of the Tasmania mine were also used at times, and I have to acknowledge Mr. Eddie's great courtesy in allowing me the use of his original plan.

My first and principal examination of the district was in January and February, 1890, though several visits were made to it subsequently, hence the state of the mine workings shown on the maps is generally as seen at that time, later workings not having been in all cases plotted. The extensions of workings made since the beginning of 1890 have not, however, to my knowledge resulted in giving any further information as to the geological structure of the ground.

Previous Reports.—Two reports on this district have been previously made to the Government—the first by the late Mr. Charles Gould in 1866, entitled "Geological Surveyor's Report of the country near Ilfracombe, in the West Tamar District"; and the second in 1883 by Mr. G. Thureau, F.G.S., on the "Beaconsfield and Salisbury Mining District." Mr. Gould's excellent report deals with the general geology of the country, and more particularly with the large deposits of iron ore near Ilfracombe and at Anderson's Creek. A full narrative of the attempt to work these ores for iron is given by Mr. T. C. Just in the "Tasmanian Official Record, 1891." Analyses of the ore, the iron manufactured from it, and the slags from the smelting are given by Mr. R. M. Johnston in his "Geology of Tasmania," on page 28; and another analysis made for Mr. Gould by Mr. G. Foord, of Melbourne, is given in the "Monthly Notices of Papers and Proceedings of the Royal Society of Tasmania, 1866," page 84. To the full information as to these interesting iron-stone deposits given in these papers, I have nothing to add further than the remark that the increasing use of chromium steel bids fair to render what was formerly the defect in the iron made from them, namely, its percentage of chromium, its principal merit at some future, but perhaps not distant date.

As regards the present mining district of Beaconsfield, gold does not appear to have been found in it till long after Mr. Gould's survey, and consequently his report mentions only the general features of the country, and does not go into further detail than giving the succession of the strata seen in the Middle Arm Creek (now called Blyth's Creek). As a general report it is most excellent, and should be consulted before the later and more detailed and restricted examinations by Mr. Thureau and myself are taken up by anyone desirous of studying the district.

Mr. Thureau's report deals more particularly with the portion of the country forming the Beaconsfield and Salisbury goldfields, and gives valuable information about the structure of the district as revealed at the time, and more especially as to the alluvial workings on the surface, and in the "deep lead" which runs along the eastern base of the Cabbage-tree Hill. As giving a description of the mines in their earlier stages of the principal features of the reefs, and of the Salisbury portion of the field which the present report does not deal with, it also should be read before this one is taken up.

The report which I now have the honour to submit to you is the result of a still more detailed examination of the Beaconsfield Goldfield, with the following objects in view :—(1.) The obtaining of more definite knowledge as to the relations of the various beds of country rock to each other and to the auriferous reefs, and their influence on the gold value of the latter; (2) The determination as far as possible of the position and effect on the reefs and the country of the various crosscourses or faults that disturb them; (3) The collection of further information as to the "deep-lead" or buried river channel running along the eastern base of the Cabbage-tree Hill; and (4) The noting in general of all facts connected with the geological structure of the district likely to be of interest and value either practically or scientifically.

General Topography and Geology.—Without going over the ground already traversed by the reports of Messrs. Gould and Thureau unnecessarily, it seems advisable to begin by recapitulating the principal facts as to the general topography and geology of the goldfield. The main feature in both respects is the low range known as the Cabbage-tree Hill, running N.W. and S.E. about two miles inland from the Middle Arm of the River Tamar, and approximately parallel to it. The hill is a little over two miles in length, and averages from 350 to 420 feet in height above sea level. The same range continues on to the south-east under the name of the Blue Tier, this and the Cabbage-tree Hill having once formed a continuous range, which has been cut into two parts by erosion of the deep gorge of Blyth's Creek, which now separates them. At its north-western end the Cabbage-tree Hill is separated by the Brandy Creek from rolling country, which forms the watershed between the latter and Anderson's Creek. From the Middle Arm the ground rises pretty evenly with a gentle slope to the base of the hill where the Town of Beaconsfield is situated. As the main street of the town is only about 100 feet above sea level, the slope from it seaward is so slight that the country may be called a plain. South of the Cabbage-tree Hill about two miles lies another hill known as the Blue Peaked Hill, and between them the ground is flat and somewhat marshy in parts. This flat extends up the Flowery Gully, an eastern tributary of Blyth's Creek, to a point about due east from the Blue Peaked Hill.

Several geological formations are represented in the district. The hills mentioned are all composed of hard metamorphic sandstones, slates, grits, and conglomerates, of probably Lower Silurian age. About a mile west of the northern end of the Cabbage-tree Hill old volcanic rocks are found, forming a large patch of serpentine country. The stratified Lower Silurian rocks are generally inclined at rather high angles of dip, and form some synclinal and anticlinal folds. Their general strike is about N.W. and S.E., corresponding with the long axes of the hills, the existence of the latter as hills being clearly due to the greater resistance offered to erosion by the hard sandstones and grits of which they are composed as compared with the softer slates skirting them. The distance to which the Silurian formation extends towards the Tamar cannot be accurately estimated as yet, as the surface is much covered with later deposits of gravels and clays. From the West Arm to the Middle Arm the shore is found to consist of sandstones, mudstones, and limestones of Carboniferous age, except at Beauty Point, where Tertiary basalts are found. The Carboniferous rocks cannot extend more than a short distance inland before the Silurian formation crops up from under them, but the junction of the two is obscured by more recent superficial deposits. These are of various ages, ranging from the early Tertiary to the Recent period, the gravels of the "deep lead" being probably of the former age, while the shallower surface gravels are more recent. The deep alluvial ground of Flowery Gully and the flat between the Cabbage-tree and Blue Peaked Hills may contain deposits belonging to the older Tertiaries as well as the recent ones visible at surface, and may perhaps in places also cover the Carboniferous formation.

The general history of the locality may be sketched thus :—Sediments of gravel, sand, mud, and calcareous matter laid down on the floor of a sea in the Lower Silurian period were hardened into grits, sandstones, slates, and limestones, crumpled into highly inclined folds, elevated into mountain ranges, and greatly worn away by sub-aerial and marine erosion in the immense interval of time intervening between their deposition and that of the later Carboniferous beds. The latter were deposited as shell-banks and beds of sand and mud at a much later date on the upturned edges of the older strata at a time when the surface of the land was relatively lower than at present, and the sea came well up to the flanks of the Cabbage-tree Hill, which at that time must have been an island or peninsula, as the Carboniferous beds are found now nearly surrounding it. No great contortion of the strata has taken place since these beds were laid down, as they still lie almost horizontal, and show no signs of metamorphism or strain due to pressure. However, between the date of their deposition and that of the early Tertiary deposits, elevation of the land must have taken place to a height probably quite 300 feet above the present level, as the next evidence of geological work which is met with in the district is the formation of the channel of the "deep lead." This is an old river channel, and the water that scooped it out must have run downhill to the sea; hence, as the bottom of the lead is proved by the Ophir Company's borings to be now 270 feet below sea level, it must at one time have been more than that distance vertically higher than its present position. This elevation of the land subsequently to the laying down of the Carboniferous beds very probably took place during the Mesozoic period, when the immense outflows of diabase greenstone, which are so prominent a geological feature, throughout the whole colony, were being emitted. This greenstone occurs very abundantly on both sides of the River Tamar from Middle Island up to Launceston. The channel of the lead was doubtless

BEACONSFIELD

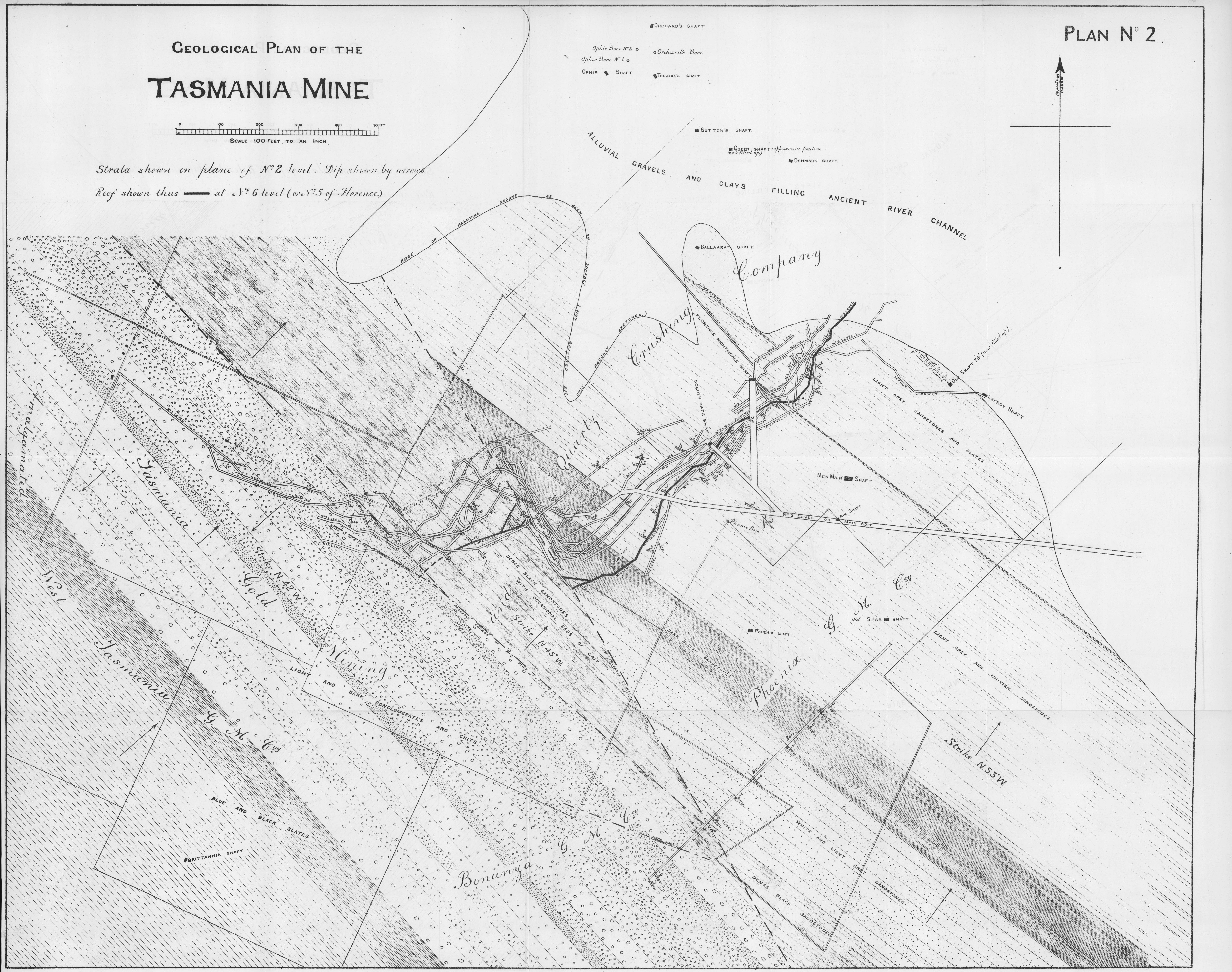
MAP SHOWING PRINCIPAL MINES WORKINGS AND STRATA IN WHICH THEY ARE SITUATED

PLAN OF STRATA TAKEN ON PLANE OF TASMANIA MINE MAIN ADIT

Scale 8 Chains to an Inch

S. Hall Surveyor
Published January
July 1901

PLAN N° 1



Geological Plan of the
Tasmania Mine
Plan No 2.
Scale 100 Feet to an Inch
0
100
200
300
400
500 FT
Strata shown on plane of No 2 level. Dip shown by arrows.
Reef shown thus —— at No 6 level (or No 5 of Florence)
North
Orchard's Shaft
Ophir Bore No 2
Ophir Bore No 1
Orchard's Bore
Ophir Shaft
Trezise's Shaft
Sutton's Shaft
Queen Shaft (approximate position) (now filled up)
Denmark Shaft
Alluvial Gravels and Clays Filling Ancient River Channel
Edge of Alluvial Ground as seen on surface (not surveyed but only roughly sketched)
Ballaarat Shaft
Company
Crushing
Quartz
Florence Nightingale Shaft
Golden Gate Shaft
Old Shaft 75' (now filled up)
Lefroy Shaft
Lefroy Crosscut
Light Grey Sandstones and Slates
New Main Shaft
Air Shaft
No 2 Level or Main Adit
Phoenix Bore
Phoenix Shaft
Old Star Shaft
Phoenix G. M. Coy
Dark Bluish Sandstones
Dense Black Sandstones with Occasional Beds of Grit
Strike N 45 W
Strike N 42 W
Strike N 53 W
Light Grey and Whitish Sandstones
Amalgamated
Tasmania
Gold
Mining
and
West Tasmania G. M. Coy
Light and Dark Conglomerates and Grits
Blue and Black Slates
Brittannia Shaft
Bonanza G. M. Coy
Bonanza Adit
White and Light Grey Sandstones
Dense Black Sandstones

eroded deeper and deeper as long as the movement of elevation proceeded, but after a time, the ground remaining stationary or beginning to subside, it began to become filled up with deposits of gravel. A movement of subsidence now appears to have set in, for the old channel became more and more filled up. At one stage it appears to have been a swampy estuary or valley, as there is in it a deposit of black mud mixed with fragments of timber, leaves, and other vegetable remains. It is from this portion of the alluvial beds that specimens were obtained of fossil fruits (see Johnston's Geology of Tasmania, page 278), which enable the age of the lead to be certainly referred to the Older Tertiary (Palæogene) epoch. This lead is therefore contemporaneous with some of the oldest deep leads of Victoria and New South Wales. As subsidence went on the old channel at last became entirely filled up. There is reason to believe that the subsidence did not cease when the ground had reached its present level, but continued until the sea reached a point on the flank of the Cabbage-tree Hill at least 250 feet above the present tide-mark. The evidence for this is that we find at 250 feet above sea-level on the Moonlight Company's section (No. 349) heavy rounded water-worn stones and coarse gravel, and at the same height on the eastern slope of the range there are heavy deposits of similar gravel in Eastman and King's and Bruen's old workings. The deposits in these consist of boulders, heavy gravel, and clay, all more or less horizontally bedded or dipping slightly seaward. Their being found on both sides of the hill up to a fairly constant level creates a great likelihood that they are remnants of a large body of gravel which once surrounded the hill up to that level, but has since been almost entirely removed by erosion. The level of the highest occurrences of heavy gravel, therefore, probably represents the sea level at the end of the last period of subsidence. From the evidence obtainable in other parts of the colony it is known that the extensive outflows of basalt which cover a large area in the northern districts, forming the best farming land, took place towards the end of the Palæogene or Older Tertiary period, and it is possible that the disturbance caused by these resulted in elevating the land again to about its present level. During the progress of this elevation (a slow movement in all probability) the deposits of gravel which had accumulated round the Cabbage-tree Hill have been swept away nearly down to the bed-rock, leaving only the remnants above mentioned and occasional gravel mounds on the plain to attest their former existence. There is some of the basalt just mentioned at Beauty Point and at Point Effingham, in the immediate vicinity of the Beaconsfield District, and a little further away, at Lefroy and Back Creek, it is again found, and this time covering auriferous deep leads. There is a possibility that the Beaconsfield deep lead may also run under the basalt towards Ilfracombe.

From a consideration of this history the obscure and patchy character of the alluvial deposits will be understood, and it will be seen that the configuration of the present surface can afford little, if any, indication of where the deep ground lies.

Deep Lead.—While this history is fresh in mind, it is well to finish our consideration of the "Deep Lead." It has long been known that along the eastern base of the Cabbage-tree Hill there exists deep alluvial ground, this being proved by numerous shafts and prospect holes. The main street of Beaconsfield (Weld-street) is almost fairly upon the centre of this ground. The principal workings have long since been abandoned, and it is hard now to fix the sites of even some of the old shafts with any certainty. Such as I could determine are shown on Plans Nos. 1 and 2. All these old workings were either on the "high reef" or sloping edge of the lead, or on false bottoms. The lowest workings were 112 feet from the surface on a false bottom of black ligneous clay. None of the workings have yet reached the "gutter" or bottom of the old river channel. I have not been able to obtain much really reliable information about the old mine workings, the accounts given by various presumably well-informed persons being very conflicting. It would seem, however, that the workings on the "high reef," that is, on the Silurian bed-rock forming the sloping sides of the channel, were fairly payable, and that there was also a good deal of gold on the black false bottom. No good section of the lead has yet been obtained. The diamond drill bores recently executed by the Ophir Company do not give a satisfactory section, as the greater part of the boring was done without bringing up any solid core, and consequently the exact nature of the strata passed through is somewhat doubtful. Two bores were put down, marked D and E on Plan No. 1, and Ophir bores No. 1 and 2 on Plan No. 2, to a depth of 375 feet and 286 feet respectively. The following section of the deeper bore was given by Mr. Bowen, the Director of the Company, who superintended the boring :—

"First bore, 375 feet, passed through from surface sandy clay with gravel to 40 feet, then pug 200 feet, then gravel containing gold at two ounces to load, then boulders to 300 feet intermixed with clay, then black clay, 50 feet, then decomposed timber, &c., then wash to bottom." Elsewhere in his report Mr. Bowen says that at the bottom of this bore there were 9 feet of wash with gold at the rate of 4 ounces to the load. The second bore bottomed on limestone at 286 feet, and had "about 12 feet wash, giving returns at 2 ounces to load." If these results are reliable the richness of the lead would be phenomenal.

The Ophir shaft, which was sunk to a depth of 300 feet in the alluvial and bottomed on sandstone, ought to have given an excellent section of the lead ; but I have not been able to obtain any more definite account of it than that it passed through a succession of beds of gravel, sand, and clay, occasionally containing a little gold. The surface of the sandstone bottom sloped to the north-east, showing the shaft to be on the south-western side of the gutter. Orchard's shaft (see Plans 1 and 2) struck limestone bottom at 192 feet, dipping south-westerly, and between it and the Ophir shaft the bores E and D strike bottom at 286 feet and 375 feet ; hence the "gutter" is evidently close to bore D. Owing to the swelling nature of the ground the Ophir shaft has become twisted and more or less useless, and no work has been done on the lead from it. The policy of sinking a shaft in the solid rock to a depth well below the lead, and then driving out under it being adopted now by the Ballarat Company, is a much safer one than that of attempting to sink in the drift itself, and much more conducive to the economical working of the gutter.

To the east of the Tasmania mine workings the lead evidently passes not very far from the Lefroy shaft. The No. 4 and No. 5 levels of the Florence Nightingale mine were driven out into it, encountering drift and gravel in the face, at depths of 270 and 330 feet. The Lefroy shaft itself seems to have been in alluvial material for about 70 feet, and then to have been sunk in soft clayey slate. The East Tasmania bore and the workings of the Dally's United mine prove that the alluvial channel keeps close in to the foot of the hill going south-east from the Lefroy shaft, and it most probably hugs the foot of the hill right to the Blyth's Creek in this direction. Alluvial material was passed through in the first 300 feet of the

Tasmania main adit, and for 412 feet in the mouth of the lower Cosmopolitan adit. Past this point I have not been able to trace it as yet to the south-east; but from the outcrops of solid bed-rock it almost certainly must pass under Blyth's Creek near the bridge on the road from Beaconsfield to Launceston. The northerly extension of the lead from the Ophir bores probably runs N.W. and then N.N.W. out under Brandy Creek. Mr. Thureau in his report gives a sketch map showing two leads coming together from the N.W. and S.E. at the Ophir ground, and then breaking out north-easterly towards the sea. There is deep ground in this latter direction, for J. T. Allen bored some 170 feet at a spot approximately marked on Plan No. 1, and was forced to stop without reaching the bed-rock by coming upon a bed of hard conglomerate boulders. The drives from the East Tasmania and Dally's United shafts, the shaft of the old Duke of Edinburgh mine, and the occurrence of solid bed-rock near the intersection of Weld and Crowther streets, together with several wells and shallow borings put down from time to time by various persons, have, however, pretty conclusively proved that there is no outlet for the lead in this direction, and Allen's bore must be in a different lead. It is probably connected with a run of deep ground found to the eastward of the Beaconsfield Public School, and perhaps this second lead may prove to be a branch of the Ophir one.

The further tracing of the lead will probably be left until such time as the works now in progress will have demonstrated the payableness or otherwise of the part about to be worked. Should the result be favourable the extensions of the lead will be of very great importance. The tracing will be rather a slow and expensive matter, as it will require series of lines of borings across the most probable courses of the old channel.

As to the prospects of the gutter proving payable there is much difference of opinion. There is no doubt that the upper portions of the gravels have been auriferous, but a very general opinion appears to prevail locally that under the false bottom on which the deepest workings are situated there will be no payable gold. The grounds for this notion are difficult to imagine. Rightly or wrongly a belief is very prevalent in the district that the good results got from the recent Ophir bores, and from a previous bore called Orchard's bore on Plan No. 2, were not genuine,—in fact, that the bores were "salted." No good reason is ever given for this belief, which is a most unfortunate one for the district, as a mere suspicion of such a thing acts as an absolute bar to investment of capital, and I quite fail to see any reason why gold should not have been genuinely got from the bores. On the contrary, there are good *a priori* reasons for thinking that the lead ought to be richly auriferous.

The channel has been eroded through the auriferous Silurian rocks. We know that the reefs existed before this erosion, for the Tasmania reef, as above stated, has been found to be cut through by the lead in the most easterly workings. It is clear, then, that a large piece of this reef has been cut out and sluiced in the old channel. But all the time that the latter was being eroded the surface of the Cabbage-tree Hill and its numerous contained auriferous veins was being also worn down, and in natural course the contained gold would find its way into the channel. The fact that the gravels filling the lead are all derived from the Silurian grits and sandstones disposes of any objection that perhaps at the time of formation of the channel the adjacent hill slopes were covered with coatings of more recent rocks, of the Carboniferous period for example. If these had existed they would have contributed their share of the gravels. Now, all the time that the river channel was being cut down, which must have been considerable, it acted as a sluice to concentrate the gold brought down from the adjacent hillsides. The later gravels derived from these same hillsides have been proved to be auriferous, then why not also the earlier ones? Further, it may be observed that while the later gravels were deposited during a period of subsidence when the channel was slowly filling up, and therefore the gravel once deposited was but little disturbed afterwards, in the earlier stage the gravel never could accumulate, but was swept out by the force of the stream which was cutting its way down through the bed-rock. While this action must doubtless result in carrying a great deal of gold down the river, at the same time it affords much greater opportunity of concentrating the gold into the bottom of the gutter than in the subsequent stages when the latter was filling up. In my opinion, therefore, there is every reason to expect that the bottom of the lead will be rich. Like all such leads it is to be expected to vary very much in quality, and no surprise and alarm should be felt if the first truck-load of wash extracted from it does not realise expectations. Patient work may be required before rich deposits are found. This is no news to anyone knowing anything of deep leads, but may be useful to other investors.

Cabbage-tree Hill.—Turning our attention now to the rocks of the Silurian system, we find that it is in those of the Cabbage-tree Hill that the most important gold discoveries have been made. Auriferous reefs have also been found at the Blue Tier, but the mines here have practically been at a standstill for a long time past. Not having examined this portion of the field, this Report will not refer to it further. The ridge of the Cabbage-tree Hill is composed of coarse-grained grits or fine quartz conglomerates, alternating with beds of hard metamorphic sandstone. On either side of the hill softer slates and sandstones are found. The general strike of the formation may be taken as that of the ridge, N.W. and S.E., though, as shown by the Plan No. 1, this is not uniformly preserved. Though a certain amount of folding of the strata can be seen in the crown of the ridge (see section) the general dip is to the north-east, the average angle of dip lying between 45° and 75°. The lowest beds of the series are therefore those seen on the western side of the Cabbage-tree Hill. The plans and section show the succession of the strata. The bluish slate, which is the lowest rock seen, is found in the Britannia shaft and in some old shafts to the north-west of the Little Wonder workings. In the extreme end of the deep crosscut at 422 feet level from the Moonlight shaft a band of fine-grained black sandstone is encountered, which must lie between the slate and the next band seen on the section, namely, a very peculiar jointed, shining, graphite-like slate. This is made up of small fragments polished brightly and striated on every face, showing the results of extreme pressure. The black colour of this rock is due to carbonaceous matter. It is encountered again in the drive south-west from the Moonlight No. 3 or most westerly shaft, and in the mouth of the Little Wonder adit, though here somewhat altered by loss of its black colouring, also in the old Garfield shaft. Upon it lies a bed of soft clayey tenacious slate, locally known as "pug." This is found with the graphite-like slate in the mines just mentioned. The next beds in the ascending series are shown by the workings of the Little Wonder, Moonlight, Amalgamated West Tasmania, and Tasmania mines to be a succession of layers of metamorphic

PLAN No. 3.

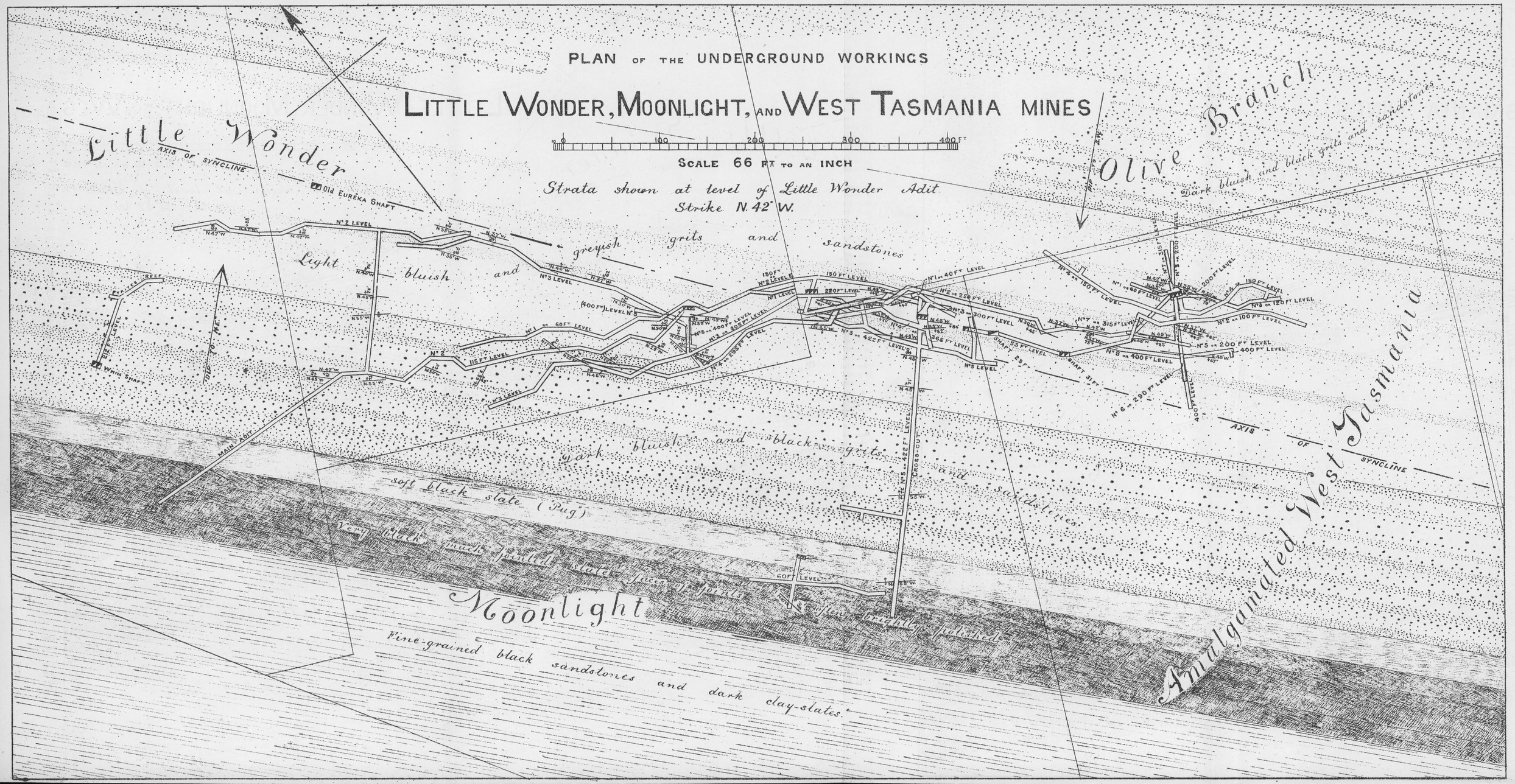
PLAN OF THE UNDERGROUND WORKINGS

LITTLE WONDER, MOONLIGHT, AND WEST TASMANIA MINES

0 100 200 300 400 FT

SCALE 66 FT TO AN INCH

Strata shown at level of Little Wonder Adit
Strike N. 42° W.

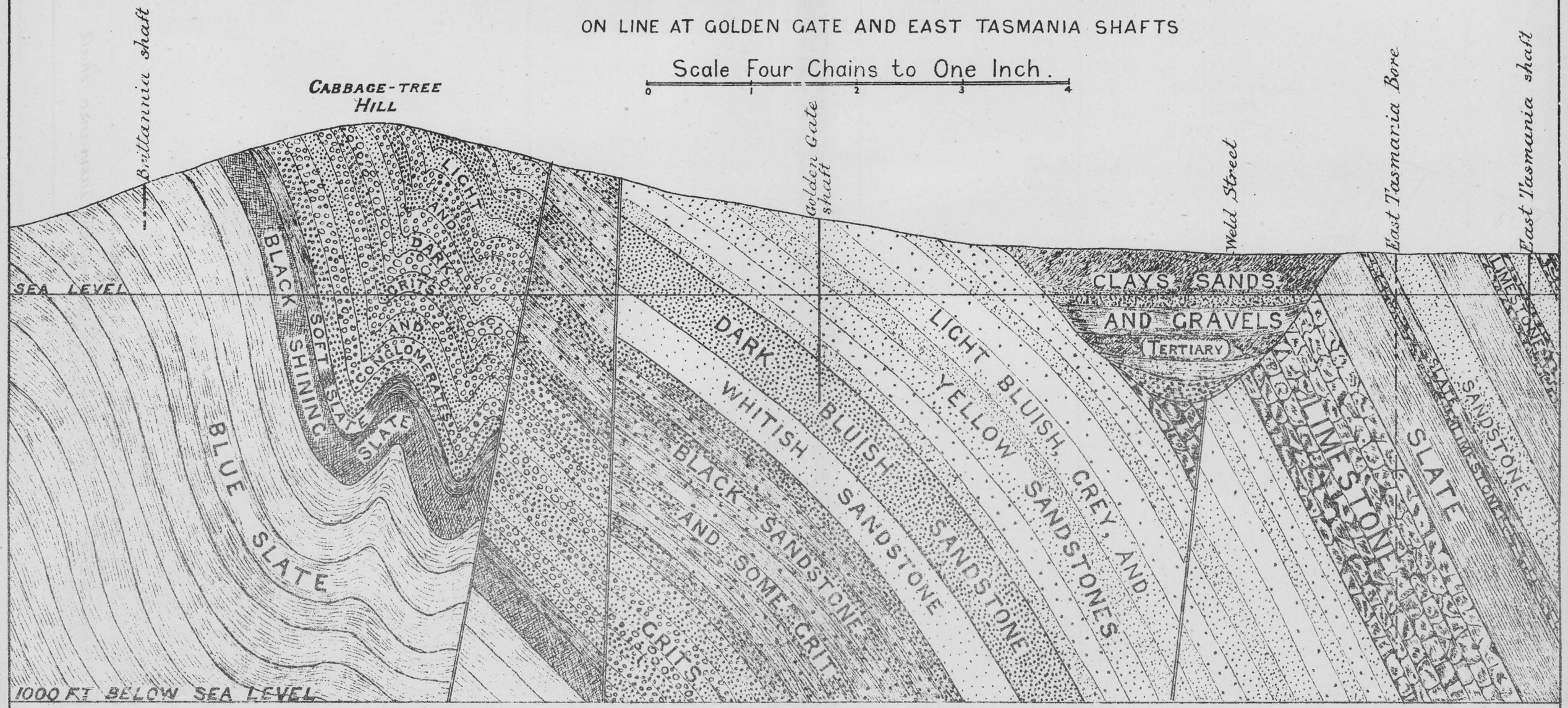


SECTION ACROSS CABBAGE TREE HILL

ON LINE AT GOLDEN GATE AND EAST TASMANIA SHAFTS

Scale Four Chains to One Inch.

0 1 2 3 4



sandstones, grits, and conglomerates. There appears to be, as shown on Plan No. 3, a layer or series of layers of black grits overlaid by another series of similar beds of much lighter colour. The lower black grits are highly charged with carbonaceous matter. In a new crosscut now being driven east from the Moonlight shaft, and in the No. 5 level of the Tasmania Mine, west of the second crosscourse, there is a great abundance of a substance, to which I can give no better name than a soft coal, mixed up with the gravel and sand forming the grits and sandstones, and often thus preventing the material from cementing together into the usual hard stone, and lying between the layers and in the joints of the rock. Though all apparently containing a large percentage of earthy matter, pieces can be readily got which will take fire in the flame of a candle, and burn like charcoal, without flame, for some time after being withdrawn from it. Heated in a closed tube a little tarry matter is given off, but so little as to show that the substance must be almost all carbon. The purest pieces are bright and shining, very soft and friable, and burn to a white ash. From the way in which the carbonaceous substance is not only interspersed through the substance of the rock, but also through joints and fissures in it, I am in some doubt as to its origin, but think that most probably there was a great deal of organic matter among the sands and gravels when originally deposited as sediments, and that, during the processes of metamorphism to which the rock has been subjected, part of this has been volatilised as oil or tar through the joints in the rock, and afterwards been completely carbonised, while part remained as carbon where originally deposited in the sediments.

Overlying the beds of grit and conglomerate comes a large band of very hard black crystalline sandstone, seen very well between the two main cross-courses in the Tasmania mine. In parts this contains layers of coarser grit, and sometimes the grain is so coarse that the rock would be rather called a grit than a sandstone ; still, on the whole, sandstone predominates in this portion of the strata. The differences in lithological character exhibited by different parts of the same bed of sediment often render it difficult to be sure of their identity. On the plan I have shown by similar marking the beds which appear to belong to the same horizon in the series, even though they do not appear to be altogether the same in character at different points. This black sandstone, for example, is more a grit towards Blyth's Creek, and also towards Brandy Creek. On the eastern side of the main cross-course in the Tasmania mine it is met with close to the fault in No. 6 level, and the diamond drill bore of the Phœnix Company went into it after passing through the reef. The lower position of this black sandstone with regard to the strata met with in the main body of the Tasmania mine workings is therefore well assured. The Phœnix diamond drill bore, the workings of the Tasmania mine, and the long adits of the Olive Branch, Bonanza, Leviathan, and Cosmopolitan Companies, give numerous excellent sections of the strata lying above the black sandstone. Three bands may be distinguished—the lowest, a white sandstone often containing numerous but very imperfect fossil casts ; next, a dark bluish sandstone which forms a well marked band in the Phœnix bore, but owing to variation in colour is not always easily recognised in the other sections ; and above this a long series of small beds of light bluish, light grey, and yellowish sandstones, with thin partings of mudstone or slate. The higher (more easterly) beds become more and more slaty in character, and thin beds of impure limestone make their appearance. These limestone beds, however, do not as yet appear to be continuous over long distances, the limestones lately struck in the Ballarat shaft, at and below 250 feet, not apparently having extended into the Tasmania mine, but been changed to mudstone and sandstone. The strata lying between the eastern workings of the Tasmania mine and the next section, that seen in the East Tasmania diamond drill bore, may be seen in places on surface in the alluvial workings west of the Ophir shaft, and are still sandstones and slates. The workings of the East Tasmania bore, the Dally's United mine, and the East Tasmania mine nearly complete the section visible. The most notable feature in this portion is the thick band of limestone met with for over 500 feet in the bottom of the bore. This is again struck in the southern drive from Dally's United shaft, and probably is identical with the large band of limestone worked in Dally's quarry, on Blyth's Creek. Beds of slate, impure limestone, slate, and sandstone succeed the main limestone mass. The next known rock in the series is a bed of hard blue limestone met with in the bottom of the East Tasmania shaft. On this again lies an arenaceous, often calcareous slate, with bands of soft schist. From this point eastward the exact succession of the strata has not been revealed. A shaft to the north-west of the Police Station shows blue slate, and the Middle Arm Creek shows a few exposures of schist, sandstone, and limestone, from which we may conclude that the higher beds are a succession of these rocks. The whole formation is evidently of immense thickness, the section now given showing over 3000 feet of rock, all on one side of an anticlinal axis running somewhere to the west of the Cabbage-tree Hill. The beds seen in the Middle Arm Creek render it probable that the thickness is very much greater still.

A very hurried visit to the Blue Peaked Hill showed it to be composed of sandstones similar to those of the Cabbage-tree Hill, and it seems possible that the strata there may be those of the latter repeating themselves on the other side of an anticlinal axis. Against this supposition, however, is the occurrence of a large quantity of solid blue crystalline limestone at the head of the Flowery Gully, which has the same strike and the same north-easterly dip as the strata of the Cabbage-tree Hill. The exact similarity of the stone to that in Dally's quarry and the East Tasmania bore leads one to suspect some connection between these beds, but as yet none has been demonstrated. I hope to have an opportunity of running a section over the Blue Peaked Hill from Beaconsfield to the Flowery Gully caves in order to elucidate this matter. It is of practical importance, as a recurrence of the auriferous strata of the Cabbage-tree Hill would probably be accompanied with similar quartz veins.

Flexures of the Strata.—Though, on the whole, the strata seen in the section across the Beaconsfield field are dipping to the north east, there are several flexures in them which in places reverse the usual dip. As seen in the section these flexures lie under the crown of the ridge of the Cabbage-tree Hill. From Plan No. 2 it will be seen that the strata in the extreme western workings of the Tasmania mine are dipping south-westerly, and from Plan No. 3 it is seen that the south-westerly dip continues to be found throughout the Amalgamated West Tasmania Mine and in the workings of the Moonlight Mine east of the shaft. Throughout the Little Wonder workings, however, the strata dip to the north-east, as they do

also in the Moonlight deep south-westerly crosscut. That there is more than one fold in the beds between the synclinal axis shown on plan No. 3 and the Tasmania Mine is seen from the section exposed in the Garfield Company's old adit. In this the strata are seen to dip towards the north-east for about 130 feet from the mouth; at 145 feet their dip is to the south-west, and continues so to about 320 feet, when they become much broken, and the dip is not clear. At the end of the adit, 447 feet from the mouth, the strata are again dipping to the north-east. Near the south boundary of Section 112, two shafts sunk by the Garfield and Little Wonder Companies show proof of further flexures, the dip of the beds in the former being south-westerly, and in the latter north-easterly. The eastern crosscut from the Moonlight shaft now being made will, if carried far enough, throw a great deal of light upon the folding of the strata under the ridge.

The only other deviation from the general north-easterly dip of any importance seen during my examination of the field was in the East Tasmania Mine, in the northern drive at the 100-feet level. One of the small limestone beds appears to be folded back upon itself where cut in a small crosscut, but the section is not long enough to show if this is more than a small local fold. It is mentioned, however, to show the possibility of further flexures being encountered in the strata in this direction.

Fossils.—I was exceedingly unfortunate in obtaining fossil remains from the auriferous formation, only getting a few broken and imperfect specimens of species already catalogued in Johnston's "Geology of Tasmania." Very good specimens of a species of *Orthis* were obtained by Mr. Davies from 242 feet in the new Tasmania main shaft, but the fossiliferous bed proved to be a very small one. Imperfect and much broken casts and impressions are not uncommon in the bed of white sandstone lying just east of the main cross-course in the Tasmania mine, and also found in the Cosmopolitan shaft. The most interesting organic remains found were the carbonaceous deposits above described as occurring in the Tasmania No. 5 level, west of the second large cross-course, and in the new eastern crosscut from the Moonlight shaft. It is noteworthy that the only specimen of a vegetable fossil yet got in this country, or, to the best of my knowledge, in Australia, in rocks of Lower Silurian age, was found at Beaconsfield, in the Cabbage-tree Hill grits, viz., *Licrophycus Tasmanicus* (see Johnston's Geology of Tasmania). Very few undoubted plant remains have anywhere in the world been got in rocks older than the higher members of the Upper Silurian system, though the occurrence of graphite in the Laurentian rocks of Canada is generally believed to be due to vegetable matter; hence the carbonaceous beds of Beaconsfield are of very great interest scientifically. I think I am not wrong in saying that these are probably the most ancient beds containing anything of a nature approaching to coal that have yet been discovered.

The fossil evidence as to the age of the auriferous rocks of Beaconsfield is scanty, and therefore somewhat unsatisfactory, but, such as it is, it points to their being of Lower Silurian age, or even older. The crystalline limestones among them have not yielded the fossil remains that might have been expected, though Mr. Gould noted the occurrence in these of imperfect remains of what were once probably corals. Mr. R. M. Johnston, in his "Geology of Tasmania," refers the limestones found at the head of the Flowery Gully to a "Primordial Calciferous Group" of probably Cambrian age. The lithological resemblance of these limestones to the comparatively adjacent ones of Dally's quarry and Dally's United mine workings, which have now been proved to overlie and be conformably bedded with the sandstones and grits of the Cabbage-tree Hill, is so strong as to lead one to feel nearly sure of their being of the same age—a conviction strengthened by their having the same strike and dip as the Beaconsfield beds. It seems to me not unlikely that the limestones of Railton, Tarleton, and Chudleigh are also contemporaneous. As, according to Mr. Johnston, the limestones of the Primordial Calciferous Group appear to immediately overlie the trilobite beds of Caroline Creek, it would therefore seem likely that the Beaconsfield auriferous rocks are contemporaneous with the latter, and should be referred to the Cambrian Period, which has yet to be done to establish clearly the relations of their various formations to each other.

Faults.—The rocks of the Cabbage-tree Hill are traversed by several faults which disturb the country very considerably, and, as they are of the greatest importance to the miner, I have devoted much attention to them and to the effects they have upon the lodes. The most important is that generally known as the "main crosscourse," running about N. 30° W., and heaving the Tasmania Reef a distance of about 240 feet. Where exposed in the workings of the mine this fault is found to be a well-defined fissure, with polished and striated walls. It is often as much as six feet wide, but varies a good deal, and is filled with crushed and slickensided masses of rock. There are often several parallel polished surfaces between the walls of the fault, forming false walls Everything gives the impression of repeated motion having taken place along this fissure at intervals of time. The striations on the slickensided surfaces are not always vertical, and are sometimes inclined at considerable angles, showing horizontal as well as vertical movement, but I was not able to detect anything certain as to the direction of the motion from these. Proof of repeated motion is seen in the occurrence of fractured quartz along portions of the fault, which must have been formed in it, and subsequently crushed and broken by pressure during a later displacement. Some of this quartz contains gold, and in places there is enough of it to have led to the quartz being stoped out and sent to the battery. It has been considered that this quartz has been mechanically broken off from the reef and carried down into the fault fissure; but after seeing the continuous sheets and strings in which it generally occurs, I cannot accept this explanation, and must conclude that the quartz has been formed by deposition in the fault fissure from solutions. Somewhat similar quartz is found in parts of the other fault fissures in the district, and occasionally carries gold. The fault is met with again in the Olive Branch adit and in the Bonanza adit, though in these it is not so clear as where opened up by the Tasmania Mine workings, and probably it extends for a long distance. Though the dip is to the westward, it is clear that the eastern is the downthrow side of the fault, which is therefore a "reverse fault." On driving westward through it, with the exception of a small patch of white sandstone passed through in the No. 2 level of the Tasmania Mine, all the country met with in the workings is dense hard black crystalline sandstone. On the east side of the fault this is found in the lowest workings of the mine, dipping under the white sandstone, and in the Phœnix diamond drill bore after passing through the reef. The downthrow of the eastern side is therefore

clear, or would appear so at first sight. The same appearance would, however, be presented if the western side of the fault had been bodily heaved northward, and this I have come to believe is the true state of the case. As seen from the plans, there is a second crosscourse to the west of the one just described. The black sandstone is found in the Tasmania mine all between these two faults, but on driving westward through the second one grits and conglomerates are encountered, showing that though this fault also dips westerly the eastern is the downthrow side. Now, as the effect of a downthrow of the eastern side of the main fault would be to heave the reef to the north of the line of the portion on the western side, it would have been expected, in accordance with the law of faults, that the drives from the Golden Gate shaft ought to have turned to the left or south-east in order to recover the reef after passing through the crosscourse. But, as a matter of fact, it was necessary to go some 240 feet to the right or north-west. This heave of the reef to the right is incompatible with a downthrow of the eastern side of the main fault, and as the evidence of the strata is conclusive as to there having either been this downthrow or else a bodily heave of the wedge of country lying between the crosscourses to the northward, we must conclude that the latter action has taken place. This lateral displacement is probably the result of several more or less vertical movements, accompanied in every case with a considerable amount of lateral thrust to the north-west. The direction of the striæ on the slickensided surfaces shows that the general direction of movement was more or less up and down, and not horizontal. In the Bonanza adit, however, a small branch drive along a slide, which is probably connected with the main fault, reveals striated surfaces with the striæ inclined towards the south-east at angles of only 12° from the horizontal, and, as above remarked, inclined striæ (in one case making angles of 30° with the horizontal) are found on some surfaces of the walls of the main crosscourse. These show that the lateral movement was at times considerable. The resultant effect of several up and down movements, accompanied with strong lateral thrust, might very well be such a sidethrow or heave as is found in the mine.

Were it not for the position in which the reef is found, there would be no reason to search for a further explanation of the position with regard to each other of the strata on each side of the main fault than the apparent one of a downthrow of its eastern wall, but, as above remarked, this is incompatible with a heave of the reef to the northward. The unusual nature of the case, therefore, leads us to inquire if there is no other possible explanation than that just given. The occurrence of quartz, occasionally gold-bearing, along the slide in considerable quantities suggests that the break found in the lode is really a "deviation," not a true "heave," and this suggestion gains further probability when the behaviour of the reef at the second crosscourse is examined into, for we find that immediately after passing this the reef appears to run off in quite a new direction, changing its course from S. 48° W. to about N. 56° W., thus turning through an angle of 76°. The current local belief that the Little Wonder, Moonlight, and West Tasmania lodes are part of the main Tasmania reef is an expression of this theory. If it be true the reef fissure must have been formed subsequently to the faulting of the country by the crosscourses, and the deviation would be due to the fissuring force partly rending open the old fractures, and being altered in direction thereby. Such deviations of lodes are not uncommon.

The question as to whether these breaks in the Tasmania reef are due to true faults or to deviations is not one of merely scientific importance, and to be regarded as of no practical moment by the commercial mining world,—on the contrary, a very practical issue is involved in it. It is this: if the breaks are only deviations it is most probable that the Tasmania and Moonlight lines of reef are one and the same; but if, on the contrary, the reef has been faulted, the western extension of the Tasmania reef has never been seen on the west side of the second crosscourse, and an important part of it has yet to be discovered.

As far as the main crosscourse is concerned, the following considerations seem to me very conclusive as to the reef having been faulted and not deviated:—(1.) The heave, or lateral displacement, of the reef remains as nearly as possible constant at the various levels from the surface down to the deepest or No. 6 level. This is characteristic of true faults, but almost, if not quite, unknown in deviations. (2.) It happens that the main crosscourse has cut through the Tasmania reef at a place where it has, in mining parlance, "taken horse," that is, has divided into two branches which have united again further on, enclosing a mass of country rock. The fault goes fairly through the middle of this horse. At every level the distance between the two branches, where they abut against the fault on its eastern side, agrees almost exactly with the distance between them, where they are found again abutting against its western side. (This is also an argument in favour of the belief that the resultant effect of the faulting motions has been simple horizontal displacement of the country northwards, as it is not likely that in any other case the widths of the horse at different levels would correspond when brought opposite to each other by vertical displacement.) It is quite incredible that a fissuring force should split the country on each side of the cross-course deviating it with such accuracy. But it is easily understood that the ends of the branches must correspond if the horse has been cut across by a fault. The horse is shown on Plan No. 2, at No. 6 level, but not at the other levels, except partially. (3.) The reef is cut cleanly through by the fault, and does not turn partly into it or drag along it as is usual in deviations. The quartz above mentioned as being found in the fault does not appear to me to be similar to the quartz of the main reef, and I believe it to be a quite separate growth.

The position of the beds of country rock on either side of the crosscourse is compatible with either theory, as they could be brought into their present relations either by simple downthrow of the eastern side or by sidethrow of the western one. If the faults existed before the reef the former supposition is most likely to be true; if not, the latter must be true. As we have seen, the evidence at the main crosscourse is all in favour of its being a true fault, formed subsequently to the reef and cutting through it.

Taking now the second cross-course, we must consider how it bears upon the question of deviation or faulting of the reef. Like the main fault it is clearly a fault as far as the country is concerned, its eastern side being black sandstone and its western one grit and conglomerate, where cut through by the mine workings. The downthrow or northerly sidethrow of the eastern side is here as plain as at the main cross-course, and again either motion would explain the relative positions of the strata on either side of the fault. The latter has beautifully defined well-polished walls, runs about N. 46° W., and dips S.W., at an angle of about 80°, being thus apparently a "reverse fault," like the main cross-course. If the reef has been faulted by this slide the continuation of it on the western side would have to be looked for to the left on going through the latter, that is the levels should turn off to the southward. They have, however, gone to the

northward, and a reef has been found which has been assumed to be the continuation of the Tasmania reef. The evidence in favour of the deviation theory seems stronger here than at the main fault, for the heave is different at different levels, an unusual thing in case of faults but normal for deviations. The reef appears to be heaved 40 feet at No. 1 level, 61 feet at No. 2, and 100 feet at No. 5. This increasing heave at different levels may, however, to my mind, be accounted for without accepting the theory of the reef having deviated, by the explanation that the stone met with on the western side of this cross-course belongs to a different reef from that left on the eastern one,—in fact, that the stone on the western side is the Moonlight reef, and on the eastern one the Tasmania reef. It will be seen from Plan No. 1 that, taking the general line of the series of viens forming the Little Wonder, Moonlight, and West Tasmania reefs, it is due to strike the cross-course very near to where the Tasmania workings have struck quartz as above described. The increasing heave of the fault would then be simply due to the differences of dip of the intersections of the two lodes with the plane of the fault. On this supposition it would only be a coincidence that the two bodies of quartz were found so near to one another at the fault. The explanation gains in plausibility when the evidence at the main cross-course is taken into account, for this, as has been shown, almost certainly proves that the reef with its enclosing country has been heaved to the northward. This implies the existence of two faults, one on each side of the heaved country. The pre-existence of the two faults is equally implied by the deviation theory, and their general or approximate parallelism would render their being of contemporaneous origin probable in any case. If we assume this to be true, and believe that the wedge of ground between the two faults has been heaved nearly horizontally northward, it will be seen that the Tasmania reef would thus be brought 240 feet nearer to the Moonlight one. If the wedge is supposed to be forced back southward till the Tasmania reef is again continuous at the main cross-course, the ends of the two reefs at the second cross-course would be 280 feet apart at No. 1 level instead of 40. There are certain considerations with regard to the nature of the reefs themselves that make it more likely that the reef west of the second cross-course is the Moonlight one and not the Tasmania. East of the main cross-course the latter, though subject to minor bendings and sinuosities, preserves a fairly straight line of strike (N. 48° E.) throughout its length. Between the two cross-courses this same strike is fairly well preserved, though several small heaves break the continuity of the line. We may therefore say that all the reef east of the second cross-course preserves a straight line of strike. In the same way the reef, or run of reefs—for there appear to be a number of more or less parallel veins—in the Little Wonder, Moonlight, and West Tasmania mines, which for convenience I have been calling the Moonlight reef, preserves a fairly straight course (N. 56° W.) up to the cross-course. It seems almost impossible that this fault should cause the reef to veer through such a large angle as 76°. The theory that the reefs are different ones seems far more probable. This probability is increased when the difference in the character of the reefs is taken into account. The Moonlight reef is notoriously bunchy, consisting of blocks of quartz which rapidly thin out to mere strings both in strike and dip, while the Tasmania reef, though sometimes pinched, preserves with great uniformity a continuous body of stone. It would be a curious and unlikely thing that the mere deviation of a lode from its former course should effect such a change in its character. The only feasible explanation of such a fact would lie in the statement that while the Tasmania reef runs across the strata of the country, the Moonlight one runs nearly with them (though crossing them on the underlay); and while the former traverses sandstones, the latter lies in grits and conglomerates, which might be expected to break more irregularly. The workings of the Tasmania mine on each side of the second cross-course show the difference in the nature of the two reefs; on the eastern side the stone is fairly continuous, but on the western one it had the same character as the Moonlight line—blocky and irregular. Immediately west of the cross-course there was good auriferous quartz from surface down to No. 2 level, but below that point the stone gave out, and at No. 3 and No. 5 levels only a "track" of the reef was visible. On driving westward also along the reef at No. 1 level the quartz soon dwindled to strings, and though these were found to lead on to several bunches or blocks of quartz, no regular body of stone could be got; in fact, the behaviour of the lode in this part of the Tasmania mine has been exactly the same as in the mines on the Moonlight line of reef. From all these considerations taken together, I feel nearly certain that the workings of the Tasmania mine, by going northward at the second cross-course, have left the Tasmania reef and struck a portion of the Moonlight line.

If we suppose, then, that these two lines of reef are separate, and existed before the faults broke them, they must have either joined together or crossed one another, the latter being the more probable on account of their directions being so nearly at right angles. Should they have done so, traces of their extensions past the intersection should be met with. No sign has yet been seen of the Tasmania reef west of the second cross-course, but no great amount of prospecting for it has been done. There appear to me, however, to be reasons to believe that extensions southward of the Moonlight line of reef have been found. Ever since the opening of the field a good deal of gold in quartz has been got along the eastern slopes of the Cabbage-tree Hill from end to end. The long drives into the ridge of the Beaconsfield, Bonanza, Leviathan, and Cosmopolitan companies testify to the general local belief in the existence of lodes running with the ridge, that is, across the line of the Tasmania reef. Auriferous quartz veins have been cut in various places, the most important workings on them being those of the Cosmopolitan Company. Bearing in mind that the Moonlight reef appears to consist of a number of veins running with the ridge, and that these are very irregular and bunchy, it seems very probable that the leaders found to the south of the line of the Tasmania reef are an extension of the run of veins found north of it.

If, then, the Tasmania reef has been lost west of the cross-course, where would be the most likely place to find it again? Owing to the sidethrow above mentioned, and to a twisting round of the strata east of the main fault so as to make their strike more westerly than that of those on its west side, it is not possible to accurately estimate the amount of downthrow of it, and hence the heave cannot be predicted. Any heave, however, should be to the southward, hence the most probable position of the faulted portion is to the south of a line connecting the Golden Gate and Britannia shafts. It is most likely to pass through either the most southerly section held by the Amalgamated West Tasmania Company or that of the Bonanza Company, but it may even be heaved to the south of the Bonanza section altogether, though this is not likely. It may seem incredible that the reef should have remained so long undiscovered if it

passes out through any of these sections, but an examination of the ground shows that very little systematic prospecting has been done, and on the western slope of the hill there is often a good deal of surface *débris*. Should the reef happen to be thin at its outcrop it might easily escape notice. The prevalent notion, too, that the Tasmania and Moonlight reefs are one and the same might have a good deal to do with diverting attention from this part of the ground. The first discovery of gold, if I have been correctly informed, was made west of the second cross-course, and on what I consider to be the Moonlight lode ; the fault was then encountered, and soon afterwards the Tasmania reef was picked up on the other side of it. The belief once held (if my information is correct) that the Phœnix shaft was on about the line of the reef shows that it was not till a good while after the lode had been first found that its true direction was ascertained. The discovery of the identity of the reef near the Golden Gate shaft with the one in the workings near the top shaft, as it is called (see Plan No. 2), was required to disprove the belief that it had not continued on or about the line of Dally's first discovery.

Before leaving the subject of these two cross-courses, a rather noticeable feature in them should be mentioned. The hade of both gets flatter towards the north-west end of the workings on them, consequently the drives at the different levels diverge fan-like, when seen in plan. This divergence is plainly seen on Plan No. 2 at the second cross-course, but that at the main cross-course is not shown. Here, indeed, it would appear that the dip of the fault changes from easterly to westerly, the Nos. 3, 4, and 5 levels lying to the east of the line of fault at No. 2, while No. 6 is to the west of it. The plan of this part of the mine is taken from the surveys sent annually to the office of the Inspector of Mines, and ought to be correct, but I have grave doubts of its being so. In all the levels the hade of the fault is to the westward, and the underground captain of the mine, Mr. Swanston, told me he had never known it to be otherwise in the stopes on the quartz found there. The large plan at the mine made by Mr. Davies, the mining manager, shows all the drives on the cross-course as lying successively further and further to the westward of its outcrop on the surface, and also exhibits the fan-like divergence of the levels at the north-west end, just as in the second cross-course. I cannot but think there is some mistake here in the official surveys from which my plan is taken.

Besides these two principal faults there appear to be a great number of smaller ones running more or less parallel to the ridge of the Cabbage-tree Hill. A somewhat larger one, but apparently of no great importance, seen in the Cosmopolitan mine, is shown on the plan, and traces of numerous others are met with in all the workings along the hill from the Garfield adit to the Cosmopolitan mine. Quartz is often found on these slides, and occasionally carries payable gold. As the axis of a syncline running N. 37° W., which as seen on Plan No. 3 passes just west of the Moonlight main shaft, has much the course of the generality of these slides, there is some foundation for suspecting that these fractures were caused by the force which caused the flexures seen in the section. There is a certain amount of probability that the veins of the Moonlight line of lodes themselves are connected with this series of fractures. I have not, however, been able to detect any faulting of the beds of country rock by these lodes, yet lying as they do almost in the same line of strike as the beds, which in this part of the field are very similar to one another, a considerable amount of faulting might easily escape observation.

Going now to the eastern end of the Tasmania mine, we shall inquire if there is any evidence of faulting here which would give a clue to where to look for the continuation of the reef in this direction, for hitherto it has not been discovered. By actual working the lode has been followed to a short distance east of the boundary between the old Lefroy and Florence Nightingale sections. The deep lead previously described cuts it off in all but the deepest level. As the lead is manifestly of much later formation than the reef, and is simply a river channel cut through it, it is absurd to ascribe to it, as is often done, any inimical influence upon the lode. The simple erosion of a river channel cannot fault or disturb in any way the continuity of the solid country from which it is carved out. Something, however, has happened to this reef, for it is not cut either in the long cross-cuts of the East Tasmania Mine or in those of the Dally's United. If the reef had continued on its course it would pass a little to the north of the East Tasmania shaft, which would strike it at about 350 feet. But no sign of it has been seen in the cross-cuts from the shaft. It is evident that one of three things has taken place, (1) either the reef has been heaved a very long way to the north or to the south, or (2) it has dipped deep in the strike with what is known as an "endlong dip," that is, instead of the outcrop coming to surface it has only come partly up through the ground, and the drives have therefore passed over it, or (3) the reef has died out altogether. The first of these is the most likely supposition. The second was to have been tested by the East Tasmania Diamond Drill bore, but unfortunately this had to be abandoned without proving anything on account of breakage of the rods, and loss of a portion of them in the bore. The third supposition is possible enough, but not to be contemplated until the other two have been proved to be impossible.

My belief that a large fault exists between the Lefroy shaft and the East Tasmania bore is founded on the relative positions of the limestones met with in the bottom of the Ophir Company's bores, and in the Dally's United Mine and East Tasmania bore, also on the marked difference in the strike of the country in the East Tasmania Mine from that in the Tasmania Mine. A glance at the section given herewith shows that in this part of the field there are two principal limestone bands, one met with in the bottom of the East Tasmania shaft, the other, and much larger one, struck at 458 feet in the East Tasmania bore, and also cut in the south drive from Dally's United shaft. From the plan it may be seen that there is no room for another large limestone band to exist between this one and the eastern workings of the Tasmania Mine. Now, what appears to be a very large body of limestone exists under the deep lead in the Ophir ground, for the Ophir diamond drill bore bottomed on limestone, as did Orchard's shaft also. The assumption that this large limestone body is the same met with in Dally's United Mine is therefore a very reasonable one. To confirm this belief, another band of limestone is found at the crossing of Weld and Crowther-streets, at about the same distance from the Ophir limestone as that in the East Tasmania shaft is from that in the Dally's Mine. While this gives great probability to the theory I am about to bring forward, it is only fair to point out that the whole argument depends on the identity of these limestone bands. When we come to try to connect the Ophir limestone with Dally's it is at once apparent that something is out of joint. An

extensive series of observations of the strike of the country rock in the Olive Branch adits, Tasmania Mine and other long adits running into the Cabbage-tree Hill, of which more hereafter, has proved that the average strike of the strata in these is N. 53° W., while a careful examination of the north drive from the East Tasmania shaft shows that there the strata strikes N. 42° W. This difference of itself would suggest the existence of a fault. But neither of these lines of strike will connect the two bodies of limestone, thus again rendering the presence of a fault between them probable. I have accordingly on the plan drawn each limestone as having the strike of the nearest strata to it which have been measured. The exact position of the fault is of course doubtful, and its direction can only roughly be ascertained by noticing that it has not been cut in the East Tasmania, Dally's United, Tasmania, or Cosmopolitan workings. As it must, therefore, have much the same course as the main Tasmania fault, it has been drawn parallel to the latter on the plan. The commonness of the occurrence of parallel faults in disturbed districts makes it likely to begin with that these would be roughly parallel. Looking at the positions of the faulted portions of the main limestone on the plan, and remembering that the workings of the East Tasmania and Dally's United mines have shown that the strata here still have a north-easterly dip, it will be seen that the western must be the downthrow side of the fault to bring the strata into their present position. A downthrow of the western side of the fault would have the effect of heaving the Tasmania reef so that its continuation on the east side would be to the south of its line on the west. The amount of heave of the strata not being extremely great, the heave of the reef could not be very extreme either, but could easily be sufficient to allow of its passing between the north end of Dally's United and the south end of the East Tasmania drives. A somewhat unexpected confirmation of this theory was furnished on plotting the position of the limestone struck in the East Tasmania bore and that got in the Dally's United mine. The dip of the strata (63°) was easily ascertained by measuring the cores brought up by the drill, and consequently the position of the top of the limestone at the level of Dally's United workings was easily found. But on joining the horizontal traces of the bed in the two places they are found not to correspond with the average strike of the country, and lines drawn through them parallel to this are found to be 104 feet apart. It would seem, therefore, that there is a fault of some sort between these two points. Now, in examining the Tasmania reef I have frequently remarked that the beds of country on the hanging wall do not correspond with those on the footwall; that the reef itself, in fact, is formed in a line of fault. This is a common enough occurrence in lodes, movement of the walls having taken place after the opening of the fissures. At No. 6 level of the Golden Gate section of the Tasmania mine a good opportunity is afforded of measuring the amount of heave of the beds of country. For some little distance westward from the shaft dark bluish sandstone is found on both sides of the reef; on the footwall side this is underlaid by white sandstones, but the dark stone continues on the hanging wall for 104 feet further, when the white sandstone comes in under it also; thus the country rock beds are heaved 104 feet westerly by the reef. As above seen, this is just the amount of heave of the hypothetical fault lying between the East Tasmania bore and Dally's workings, which is strong evidence that the reef lies somewhere there. If, now, we further remark the difference of strike of the portions of country on each side of the large north-westerly fault, which for convenience we may call the Lefroy fault, it is seen that the amount is 11°. Let us also notice that the strike of the country west of the Tasmania second cross-course is as nearly as possible identical with that of the strata east of the Lefroy fault, and that the country between these two large faults has fallen downwards—the faults being thus "trough faults." It has been seen that there is evidence of strong thrust from the southward having accompanied the downthrow of this piece of ground, and it is likely that the difference of strike of the portion in the trough between the faults from that east and west of them is due to an oblique thrust having screwed it round more to the north-west. If, now, the country containing the Tasmania reef be screwed back again so as to have its strata with their original strike of N. 42° W., the course of the reef would be N. 59° E. instead of N. 48° E., as at present, and this is the course we should expect it to have east of the Lefroy fault, and in the extension west of the Cabbage-tree Hill as well. This line is laid down on the plan as the position of the hypothetical fault occupying the probable position of the reef above referred to, and it will be seen that it goes easily between the ends of the East Tasmania and Dally's United drives. The ground lying between these ought most certainly to be tested by extending them, best towards one another. The reasoning as to the reef lying between the ends of the two drives may appear to be only ingenious theorising, and I am quite well aware that many objections could be raised to the argument: still the belief that such is the case has been forced upon me in the endeavour to reconcile and explain existing facts. The strongest point in favour of it is that it is difficult to imagine where else the reef can go. A very great heave would be required to take it either south of the Dally's or north of the East Tasmania cross-cuts. The deductions from the position of the country rocks thus agreeing with *primâ facie* probability, I feel as certain as the nature of the case permits that the eastern extension of the Tasmania reef lies where indicated on the plan.

There appear to be at least two other large faults in the Beaconsfield district—one crossing the Cabbage-tree Hill to the south-east of the Cosmopolitan and Peru mines, and another running along the Brandy Creek between the Little Wonder and Brandy Creek mines. The existence of these is indicated by the difference in strike of the strata on each side of them and by the want of agreement in position of various recognizable beds. It is not claimed that either the position or direction of these faults is correctly represented on the plan, the lines being drawn to indicate only approximately where they may be met with. To locate them with accuracy would require a very close survey of the ground in their neighbourhood, and as sections, and even exposures of the solid rock are rather rare there, it might even then prove impossible to do so. The whole district seems to be much faulted, and there are probably many faults yet to be discovered.

Strike and Dip.—In the course of my survey of this field it was found necessary to ascertain as exactly as possible the strike and dip of the strata, and some hundreds of observations of these were taken. Though, as might be expected, there were considerable local variations due to petty disturbances, it was found that on the whole the average strike of the various blocks of country separated by the main slides was fairly constant for each, though that of each block was generally different from its neighbours. The average

direction of the strata as thus found is shown on the general plan, and actual observations in the mines are plotted on Plans Nos. 2 and 3, and some taken in the gorge of Blyth's Creek on Plan No. 1. Owing to the small scale of the latter, the actual observations in the Garfield, Olive Branch, Leviathan, and Cosmopolitan adits are not figured on it. The mean of the measurements in the Olive Branch gives a strike of N. 58° W., in the Leviathan N. 51° W., in the Upper Cosmopolitan adit N. 54° W., and in the Lower Cosmopolitan adit N. 47° W. These altogether give the same average strike as is found in the eastern part of the Tasmania mine, N. 53° W., but they also give reason to believe that the strike of this block of country becomes more westerly towards its northward end. This would accord with a flattening of the dips of the faults towards their northward ends, as observed above in the case of the two Tasmania cross-courses, and with the somewhat rotatory motion previously mentioned as being the course of the difference of strike of the strata east and west of the Lefroy fault. In the Garfield adit the rock is much disturbed and the strike very variable in consequence, but the measurements give an average strike of N. 40° W., which agrees very well with that calculated from those in the West Tasmania, Moonlight, and Little Wonder mines, viz., N. 42° W.

Influence of Country Rock on the value of the Reefs.—One of the objects of this survey was to ascertain as far as possible if there was any difference discernible in the gold value of the reefs as they passed through the various strata. It has often been noticed in the history of mining that certain bands of country appear to enrich the reefs passing through them, while others have the contrary effect. In the present instance the evidence on this head shows no marked influence of the different beds on the value of the reefs, except in one case mentioned below. The Tasmania reef has been auriferous throughout all the strata traversed by it. The richest stone is found in a number of distinct "shoots" or "chutes," which, according to Mr. Davies, the mining manager, are often distinctly separated from the rest of the quartz by small sandy and clayey partings or "selvages". Outside of the "shoots," however, the quartz has been generally payable. The shoots dip easterly, conforming pretty closely with the dip of the country rock. Some remain narrow and constitute roughly parallel bands in the quartz, but two or more widen out very much in the lowest levels of the mine. The strata that have proved "favourable country" for gold in this mine may be said to be all those between the lower beds of grits and conglomerates and the main limestone bed. Owing to the loss of the quartz west of the second cross-course below No. 2 level, it is not known if the black carbonaceous grits there carry any gold. In the Moonlight and Little Wonder mines these black strata have been almost altogether barren of gold, though recent discoveries of the metal in quartz leaders cut in the new eastern Moonlight cross-cut at 422 feet give hope that they are not always so. In the mines on the Moonlight line of reef rich stone has been got in the upper levels of all, and as long as the quartz was found in the light coloured grits and sandstones, but on getting down into the black country the stone has become unpayable in every case, and, with the exception just spoken of, very rarely contains any gold at all. According to experience up to the present, therefore, the lower beds of the grits and conglomerates have proved to be "unfavourable country."

The gold-producing capabilities of the strata lying east of the present Tasmania workings and of the slate underlying the grits, have yet to be ascertained. With the exception of the limestone bands, which are not generally considered to be favourable for gold, the bands of slate, schists, and sandstone seen to the east of the Cabbage-tree Hill are similar to those proved to be auriferous a little lower in the series, and will probably therefore also be favourable. The value of the reef in the limestone remains to be proved by actual workings. Gold has sometimes been found in limestone, and it is quite possible that the reef will not suffer in value in passing through it in the present instance; still, the difference between slate or sandstone and limestone country is so great, both chemically and physically, that some change in the contained reefs may be expected, and no great hopes should be entertained until the metal is actually proved by working to be present in them.

As regards the blue slate found west of the Cabbage-tree Hill there is no proof yet as to whether it is favourable or unfavourable country. No known auriferous veins have yet been found in it, but none of the proved auriferous reefs have yet been traced into it, and on almost every goldfield there are numbers of barren veins even in the most favourable country rock. Slate of similar character is generally regarded as good country for gold, and there is therefore reason to be hopeful as to the future of the reefs when traced into this. Should a western continuation of the Tasmania reef be discovered it will soon pass into this slate, and the auriferous nature or otherwise of this will then be soon proved. The same country will be found at a depth of from 800 to 1000 feet in the Little Wonder, Moonlight, and West Tasmania mines. It seems to me that the most useful work these companies could now do would be to combine to sink the Moonlight shaft, which is the deepest and best constructed of the three, to below the "black country" in the hope of the reefs improving when they pass through it into the slate. It is probable also that by sinking thus the reefs would be got further away from the contorted strata, and there would then be more hope of having them solid and continuous, and of the numerous veins combining into one lode. The upper levels are practically exhausted, and the present lower ones are barren, hence all that remains for these mines is to find new veins or to sink for better country. The latter course commends itself as a genuine mining enterprise of the sort that has saved many a mine from being given up, and led to great success.

Remarks on the Prospects of the Mines.—Passing on to the consideration of the light thrown by this survey on the future prospects of the mines as to permanency and value, it is seen that the Tasmania mine stands in a most favourable position. There is an undisturbed body of stone from the main cross-course to the Lefroy fault, going down in favourable country to at least 1000 feet, and probably much further than it can ever be followed by mining operations. The favourable country is dipping to the eastward, as also are the shoots of gold, and it is to the eastward that the ground held by the owners of the mine stretches furthest in the direction of the dip of the reef, and consequently contains it to the greatest depth. The Phœnix diamond drill bore proved that the reef was as strong as ever at over 700 feet and rich in gold. The lode is evidently a true fissure vein, or it could not have faulted the enclosing strata. There seems no reason to doubt that it will be as large a gold producer as in the past for many years to come. The powerful new pumping appliances now in course of erection will easily cope with the water which has hitherto retarded progress so much, and to be able to overcome a still greater inflow should such occur.

The Phœnix Company should have a valuable property, but have difficulties to overcome in working it, as it lies beneath the Tasmania workings, and hence the mine will be liable to get the water from these. Owing to the shape of the boundary between the two holdings the workings of the Tasmania mine will not be of much benefit to the Phœnix until they are down to about 800 feet, as there is only a small triangular portion of the reef belonging to the latter company above that level. There are thus years of work before the Tasmania Company, if they choose, before their pumping will help the Phœnix mine. The owners of the latter, if they wish to work it, will have to provide drainage plant of their own. This would require to be equally powerful with the large new plant of the Tasmania Company, for there can be little doubt that the lower workings would soon drain the upper ones dry. The strata are very loose and open, and water gets through them freely. This was shown by the diamond drill bores both of the Phœnix and East Tasmania Companies; in neither case could the bore be kept full of water, even when tubed to the bottom with iron tubes: this, too, when the bottom of the bore was 200 and even 400 feet below the level of the water in the Tasmania mine. Another proof of the porous nature of the country is seen in the fact that there is rarely any water in the bottoms of the Moonlight, West Tasmania, and Little Wonder shafts, though these are all a long way below sea level. During the recent flooding of the Tasmania mine, however, water rose in the Moonlight shaft and remained until the former was unwatered, when it drained out of the latter also. If water can communicate so easily through the rocks with points so distant from the Tasmania mine as the East Tasmania bore and the Moonlight shaft, it seems incredible that it would not get from the Tasmania into the Phœnix mine, on the same reef and closely contiguous. It would probably be possible enough to sink the Phœnix shaft to 900 or 1000 feet without a very large pump, but when the mine was opened out, and the "bleeding" or "weeping" surface much increased thereby, the open nature of the rock is such that it would be impossible to prevent the water from the Tasmania mine finding its way down. Some water might be cut off, and led to the Tasmania's shafts to be raised, but only a small proportion, and one getting less and less as the Phœnix workings are extended. The question of drainage would be a serious one between the two companies, even if both had powerful pumping appliances, as it would be perfectly impossible to fairly allocate the burden of pumping expense between them. Only by a mutual friendly arrangement between the two as to sharing the expense could endless disputes and litigation be avoided, as the extensions of the workings of both mines would cause the inflow of water into each to be continually varying, so that no hard-and-fast rule could with justice be laid down as to how much was the proper share of each party. The best way out of the difficulty lies in an amalgamation of the two claims. All the pumping could then be done from the New Tasmania main shaft. The Phœnix ground, lying further west than the Tasmania's future deep workings, is nearer than the latter to the lower deep strata of the country, hence in the western workings the Phœnix will encounter the grits and conglomerates long before the Tasmania will. The ground is so pegged out, indeed, that the latter mine will carry the bulk of the most favourable country with it eastward. While, therefore, the former mine will doubtless have a good deal of gold in it, it must be remembered that as it goes down it gets nearer and nearer to the unfavourable black grits, and to the yet unproved slates, and its future has nothing of the same certainty about it that its neighbour's has, in consequence.

The Amalgamated West Tasmania, Moonlight, and Little Wonder mines, being all on the same line of reef, may be dealt with together. Their prospects and future policy have already been referred to, but a few more remarks may be made upon them. The Little Wonder and Moonlight have been the best producers of gold, the upper levels having been very rich. There are several veins more or less parallel to each other in these mines, and as these often pinch to mere strings, and the ground is greatly broken and disturbed in addition, the following of them has been a matter of great difficulty, and they have been often lost and not always found again. The exact number and relationship of them is therefore doubtful. In the main workings of the Little Wonder two larger branches diverge northward from near the shaft, and in the opposite direction come together and run into the Moonlight ground. The old Olive Branch Company had a small portion of this reef in the south-west corner of their western section, and worked it with considerable success till it dipped away into the Moonlight ground. The general dip of this line of reef is to the south west. The Moonlight Company have been very persevering in their attempts to find gold at a depth, and have done a great deal of prospecting at their 422 feet level, assisted in this by a subsidy from the Government. Their long south-western cross-cut, though unsuccessful in cutting any reefs of value, has proved a considerable stretch of ground, and has afforded an excellent section of the strata that has been of the greatest service to me in preparing this Report. The old Olive Branch sections having fallen into their hands, they are now driving eastward from the main shaft, and have cut some leaders and bodies of quartz that give promise of greater success in the future. The development of these discoveries is suspended until the completion of a contract for driving this eastern cross-cut. One leader contains a little gold. In the workings near the surface the Moonlight reef appeared to dip north east—that is, away from the shaft,—then it became vertical, and finally turned towards the shaft and passed through it, dipping south-westerly.

This has often led to a suspicion that there were two "legs" to this lode, one dipping north-east and another south-west. Owing to the proximity of their boundary line, the Moonlight Company were not able to test this supposition until lately, when the Olive Branch ground was acquired, and these discoveries in the eastern crosscut give some support to it. The Olive Branch Company also drove easterly from their shaft, but did not get any lodes of importance. The belief in an easterly leg of the Moonlight lode seems borne out by last year's (1890) workings of the West Tasmania Company, who, after picking up the reef in the old surface workings of the Moonlight, followed it to the south-east, and extracted 507 tons of quartz, which yielded 549 ounces of gold. This stone was found to dip to the north-east, and at 200 feet passed through the West Tasmania shaft. Workings on it at the 150 feet level were carried on up to the Olive Branch boundary. This is the only gold-bearing stone of any consequence yet got in the West Tasmania Mine, with the exception of a little that was obtained in the 315 feet level where it joined the Moonlight 250 feet. All the other workings have been on thin veins and tracks not worth stoping out. This lode was of a very peculiar character, and extremely difficult to follow. The quartz was found in the most irregular bunches, connected by nothing but clayey "tracks" and occasionally thin veins of quartz, and was enclosed in a jumbled mass of sandstone and grit fragments, mixed with clay and sand. On examina-

tion I came to the conclusion that there was here a rather wide lode fissure filled with broken fragments of the wall-rock, amongst which the quartz had been deposited, thus accounting for the very irregular distribution of the latter. The filling of the lode is mainly composed of loose angular fragments of sandstone, grit, and conglomerate, sometimes crushed or disintegrated into loose sand and gravel. In places open spaces were found into which an arm could be thrust up to the shoulder. Throughout the broken formation no trace of regularity of stratification could be observed, but in one or two crosscuts through it the solid regularly stratified rock was to be seen, proving the nature of the occurrence to be of the "mullock lode" type. Where the main shaft had been sunk through it there was no definite body of quartz, and consequently the fact of there being a lode was not noticed. From the size of this formation I should expect that the fracture of the rocks shown by it is an important one, and, as lodes filled with fragments of wall-rock frequently are found on being followed to narrow and become filled with quartz or other proper lode material, I think that it would be well worth while to trace this one further, in the hope that it would so change. All the quartz so far found in it has been highly payable, and, should the filling change to a defined quartz reef, there would be every hope of it proving payable also.

There is a somewhat similar lode to that just described, and also dipping to the north-east, found in some workings from what is known as the Moonlight No. 3 shaft. A drive on this lode at the 60 feet level showed it to be filled with a broken mass of country rock and occasional pieces of quartz. No gold was got in these, however. This mullock lode also should be traced further, in the hope of its changing to quartz.

As above said, the future of these three mines depends on finding new lodes or branches of those already known, or on sinking deeper. A good prospecting work would be a drive from the Little Wonder shaft south-west into the Moonlight ground far enough to make sure that none of the veins worked upon in the No. 5 level of the latter mine have turned off along the boundary of the two sections. A crosscut north-east from the same shaft would also prove some very likely ground. Sinking, however, seems to me the best policy of all.

Only two other mines now working have found reefs—the Cosmopolitan and the Brandy Creek. The latter was shut down on the only occasion when I had an opportunity of visiting it, and I was only able to go hurriedly through the former once, consequently I have little to say about them. The Cosmopolitan workings are unfortunate in being situated in what appears to be a regular network of small slides, which have cut off the quartz repeatedly. A great deal of driving has been done to get to the reefs, but very little real work on them. Good gold-bearing stone has been at times obtained, and, if the mine were opened up better, it might produce a good deal, but the numerous slides have hampered work very sadly. It will be necessary to get the reef in less broken country before work can be profitable.

Marble.—The blue-black crystalline limestone found in the East Tasmania bore takes a very good polish, and is really a very handsome marble. When polished it is nearly black, the bluish shade in the colour being only perceptible on close inspection, and numerous veins of pure white calcite give variety and beauty to it. The stone works well, being close-grained and hard. There should be no difficulty in getting blocks of uniform texture and any required size from Dally's quarry on Blyth's Creek (where this marble is being burned for lime), or more easily still from the large masses cropping out at the head of the Flowery Gully. If worked by skilled marble-workers I have no doubt that this stone could be sold profitably in considerable quantities for ornamental and monumental purposes. The quantity easily got at is very large, and the facilities for quarrying are good; while the proximity to a shipping place, and ease with which tramways could be constructed from it to the quarries, are very favourable for cheap transport to either the local or the Australian markets.

The pale bluish white marble found at the old limekiln at the second bridge on the road from Beaconsfield to Launceston would also be of commercial value if easily obtained. As the workings of the old quarry on this bed are now full of water I cannot speak as to the size of it, or as to whether large blocks could be got of uniform texture and free from flaws. If, however, the loose stones lying about fairly represent the general quality of the marble it would be well worth quarrying.

Besides the marbles there is another stone in the Beaconsfield district that would be very useful for ornamental work, namely, the Serpentine that occurs abundantly in Anderson's Creek. This is found of great variety and beauty of colouring, and could be made into a great number of highly ornamental articles. Various shades of green and very pretty mottled serpentine are quite common.

Appendices.—As no topographical features are shown on the plans accompanying this Report, I append a number of heights above sea level of various points throughout the district. These were taken by means of an aneroid barometer, and consequently are only rough approximations to the true levels, but will be useful for purposes of comparison.

I also append sections of the Phœnix and East Tasmania diamond drill bores.

Thanks.—During the course of my survey of the district I received much useful information and many courtesies from the mining managers and other gentlemen throughout the district, whose help and kindness is now gratefully acknowledged.

I have, &c

A. MONTGOMERY, *M.A., Geological Surveyor.*

The Secretary of Mines, Hobart.

Appendix No. 1.

HEIGHTS above Sea Level of Points in the Beaconsfield Goldfield, approximately determined by Aneroid Barometer.

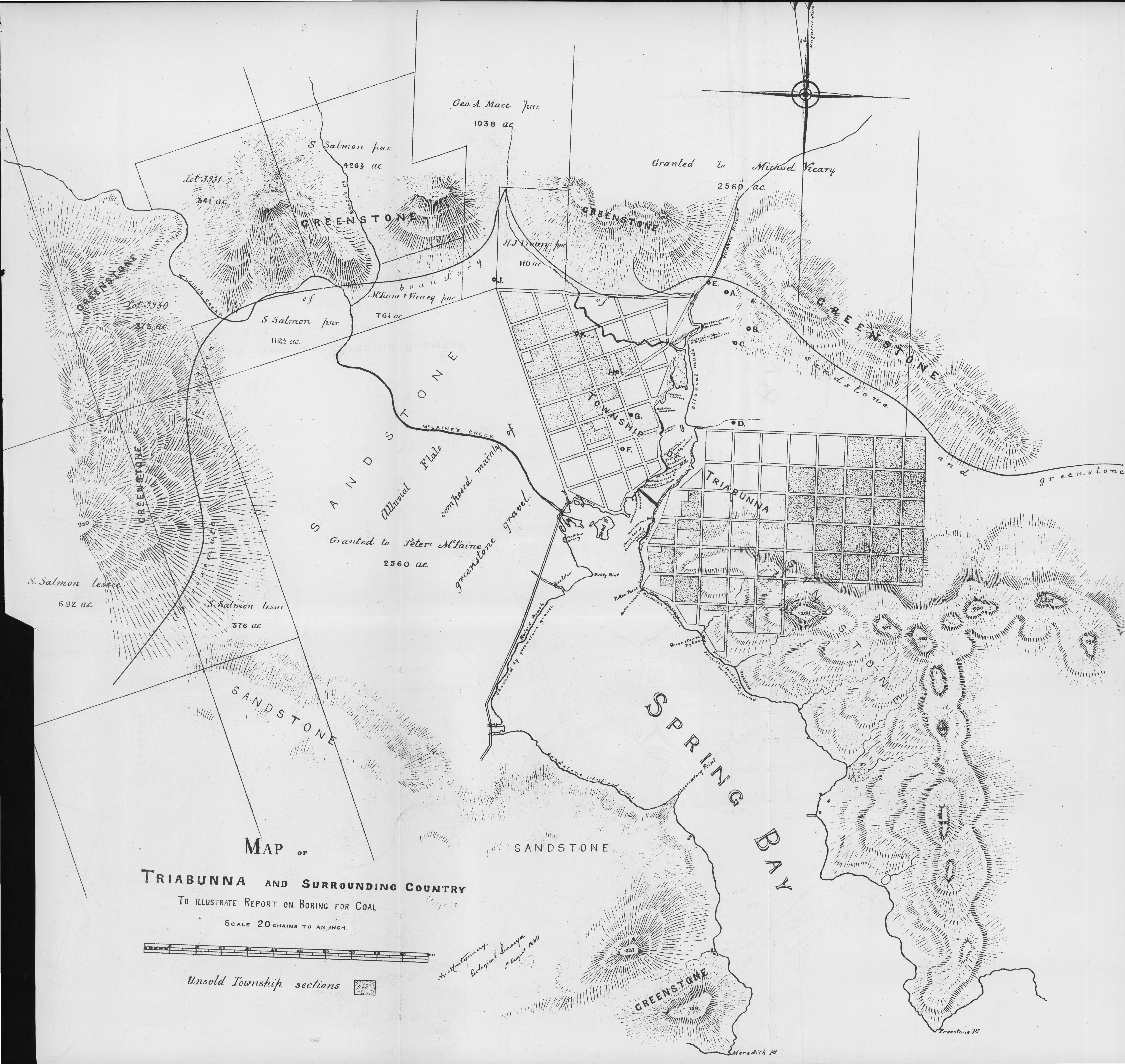
	Above H.W.M. Feet.
Weld-street, opposite Club Hotel	105
Top of Lefroy shaft	125
Florence Nightingale shaft	153
Dally's United shaft	117
Golden Gate shaft	186
Ballarat shaft	168
Ophir shaft	127
New main shaft, Tasmania	159
East Tasmania shaft	86
West Tasmania main shaft	352
Moonlight main shaft	334
Moonlight No. 3 shaft	262
Little Wonder shaft	321
Little Wonder shaft on Garfield Section	321
Mouth of Little Wonder main adit	204
Garfield adit	213
Bonanza adit	172
Leviathan adit	195
Cosmopolitan upper adit	204
Cosmopolitan lower adit	96
Top of Old Britannia shaft	276
Phœnix bore	213
East Tasmania bore	86
Ophir bores	120
Denmark shaft	110
Bonanza air shaft	231
Cabbage-tree Hill on line of Bonanza tunnel	411
Old shaft near Phœnix and Bonanza boundary	330
Leviathan air shaft	321
Kohinoor shaft	375
Cosmopolitan shaft	258
Hematite shaft	195
Air shaft on lower Cosmopolitan adit	163
Old New Providence prospecting shaft	348
Tasmania open cast workings	348
King and Eastman's alluvial workings	249
Old Stanley shaft	101
J. T. Allen's bore	65
New Brandy Creek shaft	155
Pease's shaft	164
Old Brandy Creek shaft	177
Excelsior shaft	190
Dundee shaft	191
Mouth of London adit	155
Brandy Creek old surface drive	159

Appendix No. 2.

SECTION of Strata afforded by the Phœnix Company's Diamond Drill Bore.

Strata.*	Thickness. ft.	in.	Total Depth. ft.	in.
Alluvial surface matter	4	6	4	6
Hard, brittle, whitish, and yellowish fine-grained sandstone, breaking into small rhombohedral fragments; very much jointed; would not form core; contained a few very thin quartz veins; flinty and somewhat crystalline in texture	368	4	372	10
Fine-grained, dark bluish, somewhat crystalline, sandstone, much jointed, and yielding little solid core; contained occasional specks of pyrites; a band of grey micaceous sandstone at 472 feet, but only very thin	119	8	492	6
Light grey and whitish sandstone, with occasional bands of grey slate; impressions of fossils rather numerous, but imperfect; sandstone more granular and porous than the preceding bands; gave a few inches of solid core at times	213	0	705	6
Tasmania reef—Quartz containing iron and copper pyrites; gold freely visible	24	6	730	0
Dense hard crystalline dark blue or black sandstone, with a good deal of pyrites in it	50	7	780	7
Total	780	7	780	7

* Dip of strata 58° (average of 12 measurements of angle of dip visible on cores).



Map of
Triabunna and Surrounding Country
To illustrate Report on Boring for Coal
Scale 20 chains to an inch.
Unsold Township sections
A. Montgomery
Geological Surveyor
6th August 1890
Geo A Mace pur
1038 ac
S Salmon pur
426½ ac
Lot 3331
341 ac
Granted to Michael Vicary
2560 ac.
GREENSTONE
H J Vicary pur
110 ac
boundary
of
McLaine & Vicary pur
76½ ac
S. Salmon pur
112½ ac
Lot 3930
375 ac
SANDSTONE
Alluvial Flats
composed mainly of
greenstone gravel
Granted to Peter McLaine
2560 ac.
McLAINE'S CREEK
TOWNSHIP
TRIABUNNA
S. Salmon lessee
692 ac.
S. Salmon lessee
376 ac.
sandstone
sandstone and greenstone
SPRING BAY
Meredith Pt
Freestone Pt

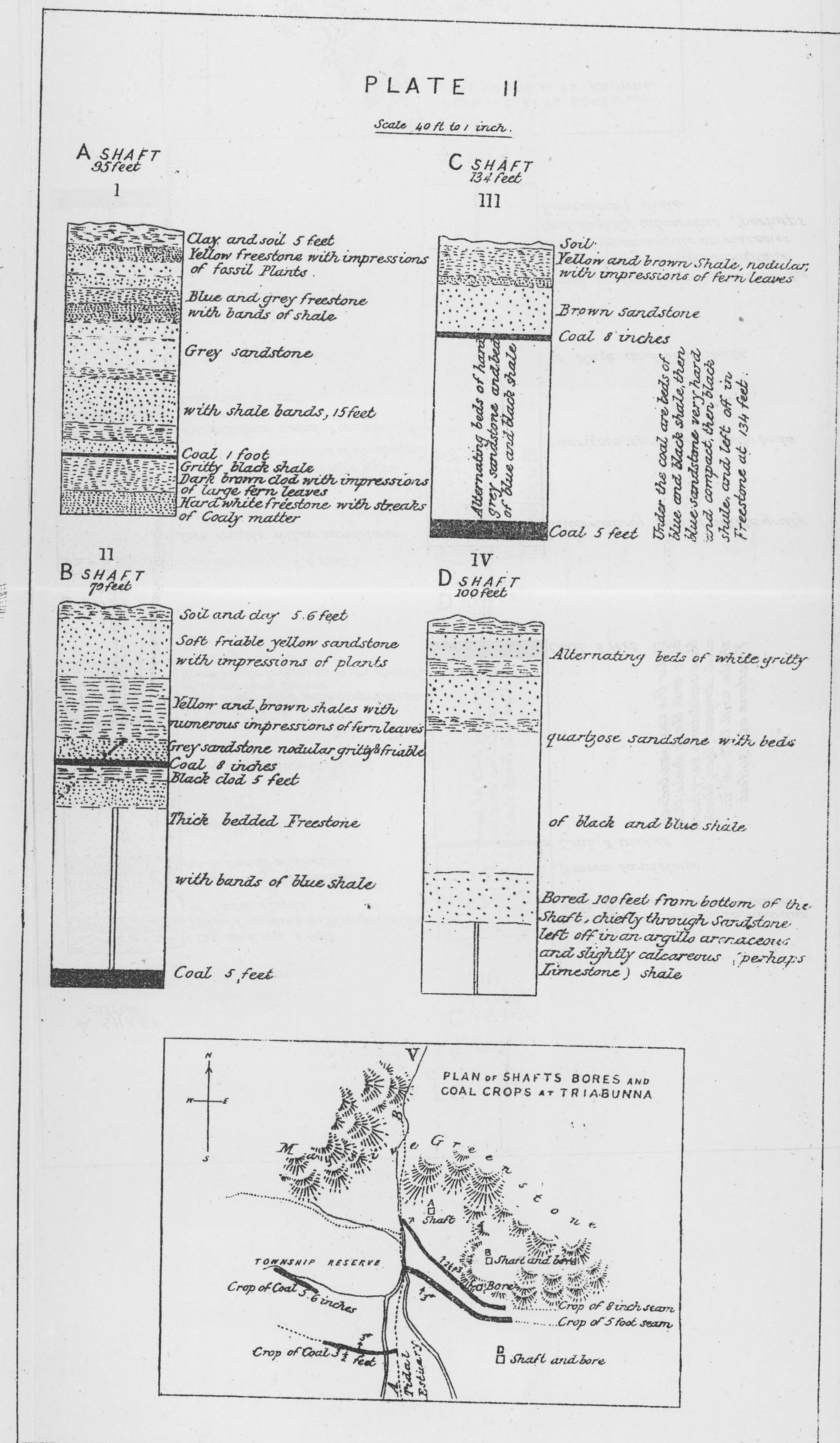


PLATE II
Scale 40 ft to 1 inch.
A SHAFT
95 feet
I
Clay and soil 5 feet
Yellow freestone with impressions of fossil Plants.
Blue and grey freestone with bands of shale
Grey sandstone
with shale bands, 15 feet
Coal 1 foot
Gritty black shale
Dark brown clod with impressions of large fern leaves
Hard white freestone with streaks of Coaly matter
C SHAFT
134 feet
III
Soil
Yellow and brown Shale, nodular, with impressions of fern leaves
Brown sandstone
Coal 8 inches
Alternating beds of hard grey sandstone and bed of blue and black shale
Coal 5 feet
Under the coal are beds of blue and black shale, then blue sandstone very hard and compact, then black shale, and left off in Freestone at 134 feet.
II
B SHAFT
70 feet
Soil and clay 5.6 feet
Soft friable yellow sandstone with impressions of plants
Yellow and brown shales with numerous impressions of fern leaves
Grey sandstone nodular gritty & friable
Coal 8 inches
Black clod 5 feet
Thick bedded Freestone
with bands of blue shale
Coal 5 feet
IV
D SHAFT
100 feet
Alternating beds of white gritty
quartzose sandstone with beds
of black and blue shale
Bored 100 feet from bottom of the Shaft, chiefly through Sandstone left off in an argillo arenaceous and slightly calcareous (perhaps Limestone) shale
V
PLAN OF SHAFTS BORES AND COAL CROPS AT TRIABUNNA
TOWNSHIP RESERVE
Crop of Coal 8 inches
Crop of Coal 5 feet
Crop of 8 inch seam
Crop of 5 feet seam
Shaft and bore

SECTION of Strata afforded by the East Tasmania Company's Diamond Drill Bore.

Strata.*	Thickness.	Total Depth.
	ft. in.	ft. in.
Surface soil and clay	12 0	12 0
Brown, grey, yellow, and bluish sandstone, with small quartz veins; some grit as well as sandstone, also thin bands of slate	68 10	80 10
Slate similar to that found in the 100 feet level of the East Tasmania mine, rather soft, greenish, arenaceous, and calcareous; vein of calcite and pyrites 2 inches wide at 116 feet	35 2	116 0
Impure silicious limestone with calcite veins; vein of dense whitish grey hard quartz at 120 feet	64 0	180 0
Dark black, bluish grey, light grey, and dense blue grey fine grained slates, containing a little pyrites and a few small quartz and calcite veins	278 0	458 0
Dense dark blue fine grained crystalline limestone or marble, very solid as a rule, but occasionally fractured. The drill ceased working while still in this rock	520 4	978 4
TOTAL	978 4	978 4

* Average dip of strata 63° (mean of 19 measurements of angle of dip shown by cores).

REPORT ON THE GENERAL GEOLOGICAL STRUCTURE AND TIN-BEARING GRAVELS OF THE GLADSTONE DISTRICT.

Geological Surveyor's Office, Launceston, 27th July, 1891.

SIR,

I have the honor to report having made a general geological examination of the Gladstone District, and more especially of the ground held there for tin-mining purposes, with the object of collecting information that might prove of service to the mining industry by throwing greater light upon the origin and mode of deposition of the tin-bearing gravels, their extent, and their distribution throughout the district.

A general view of the topography of the country round Gladstone is best obtained from the top of Mount Cameron, 1808 feet above sea level. The mountain consists of a cluster of rocky peaks connected by high ridges, the group being divided into three main spurs by the valleys of the Campbell's and Sapphire Creeks. It is isolated from all other neighbouring ranges, being surrounded on all sides by low-lying country, which slopes gently seaward from the foot of the mountain towards Boobyalla, and on the inland side rises gradually in rolling low ridges up the Ringarooma valley towards the foothills of the Blue Tier and the high ground near Branxholm. On the western side the wide flat low-lying valley of the Boobyalla River divides it from Mount Horror. Towards the eastward there is little high country, the low Ringarooma Tier and the distant Mount William being the most prominent features, but the whole consists of a succession of low ridges, separated by plains anl a few deeper valleys, that of the Ringarooma River being the most important. The land is generally but sparsely timbered, and large open spaces clothed with native grasses give it a park-like character. The open grass land generally denotes the presence immediately under the surface of a hard, somewhat ferruginous, cement layer or "pan," which is especially found covering the deposits of gravel. The ridges and slopes where the solid bedrock lies near the surface, when not too rocky, generally bear more vegetation than where the "pan" occurs.

The general aspect of the country as seen from the top of Mount Cameron suggests that the low-lying country has been planed down to a pretty uniform level by marine erosion, and has subsequently been furrowed into minor ridges and valleys by the action of running water and other sub-aerial agencies. It would therefore appear as if the sea had once covered all the low-lying ground and extended inland to the foot of the ranges. This appearance is general at intervals all along the northern coast of the Colony, and the probability is that, as a matter of fact, the land has risen very considerably since the end of the Early Tertiary (Palæogene) Period. This explanation is of great service in reading the history of the various gravel deposits, enabling them to be correlated and their differences explained with a success which no other theory appears to me to approach. Further evidence in support of it is given below.

General Geological Structure.—The bedrock visible throughout the district is either granite or ancient sedimentary slates and sandstones of probably Lower Silurian age. On these rest gravels of ages ranging from the early Tertiary down to the present time. No Upper Palæozoic or Mesozoic rocks of our Coal Measure series have, to my knowledge, ever been found in the vicinity of Gladstone intervening between these two formations. Recent basalts, probably of Tertiary age, are sparingly found, however, and must be taken some notice of.

Granite.—The Mount Cameron Range is part of a large mass of granite country which extends from between Boobyalla and Gladstone southward to Branxholm and the George's River, and includes the whole of the Blue Tier Range and its offshoots. The boundary between the granite and slate formations is a very sinuous line, but may be said to run roughly about N.W. and S.E. through a point just west of Gladstone township. The granite is of the same character as that composing the Blue Tier, the Billycock Tier, Mount Stronach, and other granitic hills of the North-eastern District, namely, a felspar porphyry consisting

of quartz, mica (*biotite* mostly), and felspar in coarse granular mixture, with large felspar crystals porphyritically developed. In vughs in the granite the quartz frequently is found in large black crystals of fine quality. Generally the rock is of a whitish light grey colour, but occasionally it is red, the felspar being of a brick-red colour. In parts it may be seen of a warm cream colour, and without the large porphyritic felspar crystals. The rock is very subject to decomposition, the felspar rapidly altering to kaolin, and the mica to clayey and serpentinous earths. The insoluble quartz grains alone remain unaffected by the atmospheric agencies. They are angular, and rarely show any approach to definite crystalline form, and range from the size of small shot to that of peas, forming therefore a very light gravel when broken down by the weather and very readily moved by running water; whence it happens that the rarer large quartz crystals and masses found in vughs and veins of the granite being left behind by the lighter material, form a preponderating proportion of the heavier wash. This serves as some measure of the amount of concentration of the heavy material in the creek beds, for every cubic yard of coarse gravel must represent some hundreds of yards of broken down granite, as the latter contains only a very small percentage of vein rock and large crystals. Similar reasoning will show that if even a very small quantity of tin ore exists through the granite, whether in the rock itself or in small veins through it, the concentration has been sufficient to allow of very considerable quantities having been gathered together in the creeks. There can be little doubt that the granite does contain a little tin in its mass irrespective of any occurring in veins traversing it. Every little creek on the granite bedrock is found to contain some tin ore, and tin-bearing veins are so rare that they cannot be relied on as the source of this. In a previous report on the Blue Tier District I suggested that a good deal of the alluvial tin ore was derived from the disintegration of the granite bedrock, and my examination of the tin-bearing creeks of Mount Cameron tends to confirm that belief.

The fine quartz from the disintegration of the granite is a very useful indicator of the proximity of the bedrock. It is washed clean by rains, and gathered together by small runnels of water into white patches, often resembling small hailstones. If on examination the grains were found to be sharp and angular, I have found that in every case that came under my notice further search showed the bedrock to be immediately under the surface,—in fact, the surface soil was only disintegrated rock. Where, however, there was a considerable percentage of rounded water-worn grains, there was always alluvial material underneath. This simple observation was of great service when the nature of the bedrock was not at once visible. Where the fine quartz gravel has been much water-worn, it generally forms fine rounded grains like rice or barley in appearance and size.

The granite has been evidently intruded through the Silurian strata, as is shown by the very sinuous boundary between the two formations, and the fact that the slates and sandstones at the contact are often greatly metamorphosed and rendered somewhat crystalline. A shaft sunk on the Mount Cameron Company's ground went for some seventy feet through slate, and then struck granite. The strike of the Silurian beds is in many places fairly against the granitic masses, which thus cut them off sharply. The intrusions of granite are therefore post-Silurian in date.

In my former report on the Blue Tier District, the occurrence was noted of a second variety of granite traversing the above-mentioned felspar porphyry as dykes, and generally carrying a great deal of tin ore impregnated through it. Somewhat similar rock is also found at Gladstone and here, too, is apparently much more richly stanniferous than the ordinary granite. As at the Blue Tier it varies greatly in composition, being in parts composed almost wholly of quartz and mica or hydro-mica, and in other parts of about equal quantities of quartz and felspar, while in other places, again, all three constituents of granite are found. Much of the mica is white and silvery *(muscovite)*, thus differing from the black mica *(biotite)*, of the country rock. Quartz is generally predominant, however, and in much larger crystals than the felspar and mica ; hence though the rock is by no means a typical *quartz-porphyry*, in the absence of a better name this one may be given to it. Where veins traverse this porphyry the felspar is generally gone from their immediate neighbourhood and the mica become hydrated, while infiltration of silica has cemented the material into a hard solid rock. Often a vein of well formed vein-quartz runs through the centre of the altered mass. These veins are often very rich in tin ore, both in the quartz and in the altered country rock. Several of these quartz-porphyry dykes have been found in the Gladstone District; the largest, perhaps, being on the Fly-by-Night claim, where it lies between the Silurian formation and the main granite mass. This would suggest a probability of its being a contact alteration product, that is, that the portion of the granite coming in contact with the sedimentary rock had been altered in composition and crystallised differently from the main mass in consequence. As, however, there is not this alteration at other points of the contact, and, besides, the porphyry traverses the main granite itself on the Esk Company's ground, it would seem that its being a contact mass on the Fly-by-Night is only accidental. The intrusive character of the quartz-porphyry is not so clear as at the Blue Tier, and it may prove on further examination not to be a true dyke, but rather granite altered by fracture and infiltration of metamorphosing solutions. At present, however, I incline to the belief that it is dyke-stuff intruded though the granite.

Running a few degrees east of north from above the Esk Company's pumping plant on the east side of the river is another outcrop of the quartz-porphyry, and still another occurs further on on the old Empress claim. These may prove to be connected with the Fly-by-Night dyke, but as yet no attempt has been made to trace them through. Since my visit to the district I have been informed of the recent discovery of a large soft granitic lode rich in tin ore on the Mount Cameron Company's property, from the appearance of specimens from which I should think that it is probably connected with the adjacent Fly-by-Night dyke, if not really a continuation of it. On the Esk Company's sections, on the slopes towards Harden's Ravine, several tin-bearing veins have been cut by trenches, but I am not sure whether they are in another dyke of quartz-porphyry or are simply small lodes in the granite. They are small and rather irregular, but often carry excellent tin ore. More extensive trenching across their course is required to make clear their true nature. In the quartz-porphyry dykes tin-bearing veins are very numerous, and run in all directions. On the Fly-by-Night section there are a great many of them, and so much rich stone can be readily obtained as to render it probable that the rock would be payable if systematically worked. On Mallinson's section, No. 167, there is something more like a definite lode than the generality of the veins. Here, in the width of about a chain, are found three or four veins of quartz impregnated

with silvery talc and flanked by bands of blackish greasy talc, the whole width of the lode bands ranging from one to five feet. Tin occurs pretty freely in these bands, and in what is said to be a bulk sample taken from a shaft on one of them as much as 12½ per cent. of dressed tin ore is reported to have been obtained. This lode is worth prospecting: it could easily be tested by a short adit and drives along its course. Neither here nor on the Fly-by-Night ground has any real mining work been done to try the lodes—nothing, indeed, but a few trenches and pits. Endeavours have been confined to searching for definite lodes to which it was supposed the numerous veins would lead. As the tin ore appears to be impregnated through the bulk of the quartz-porphyry generally, and segregated especially in the vicinity of the veins rather than confined to them, it appears to me that efforts should be made to ascertain the average value of the formation rather than to trace the separate veins. These do not seem at all likely to be permanent, and it is very doubtful if definite lodes exist at all in the formation. The experience of the Anchor mine at the Blue Tier in crushing the quartz-porphyry dyke there in bulk proves that this treatment is the proper one to pursue, and not rooting out small rich veins. No great amount of attention has yet been paid at Gladstone to the stanniferous dykes, but they are, in my opinion, promising enough to be worth a systematic trial, which would ascertain if they would pay for treatment in bulk. Both the Fly-by-Night and Mallinson's dykes offer extremely good facilities for cheap extraction of the ore by open quarrying. One per cent of dressed tin in the stone, taken as it comes, ought to pay all expenses and leave a margin of profit, provided that a sufficiently large quantity per diem were treated. This may seem to some an absurdly low estimate of cost of extraction and crushing, but numerous examples of successful dividend paying mines could be cited where the value of the rock mined is much less than that represented by one per cent of tin ore, and in some of these cases the ore has to be raised from a depth of as much as 2000 feet with concomitant pumping as well as winding expenses. It has been thoroughly demonstrated that no mines pay so well and steadily as those where there are very large quantities of low grade ore of only sufficient value to give a small profit over expenses of treatment on a large scale. Worked on a small scale they would be unpayable, but, with the greater economies possible in working on a large scale, handsome profits are realised. Great quantity of material dealt with is the secret of their success. What is required now, therefore, in the case of these dykes at Gladstone, is to ascertain the quantity and value of the stanniferous rock easily available. The course of the porphyry formations should be ascertained by trenches, and a number of small shafts should be sunk in them at regular intervals so as fairly to sample the rock. The stone from these shafts should be all crushed and dressed without any picking of good stone or rejection of bad. The result of the crushing would show what could be expected from the porphyry as a whole, and would allow of a calculation being made as to whether it could be made to pay when milled on a large scale. Even if the rock as a whole would not pay to work it would be seen by such a trial if it would be possible to select large quantities of payable stone without having to remove so much poor rock as to cause a loss. It may be pointed out that the cost of such a thorough test, implying as it does the provision of a small experimental battery for crushing the rock from the shafts, would not be greater than has to be sunk in preliminary prospecting operations in many other mines where the results obtained are often not nearly so definite nor the prospects so good.

Silurian Formation.—The bedrock underneath the township of Gladstone, and, generally, east and north-east from it, is composed of metamorphic slates and sandstones having an average north-and-south strike (my observations of strike vary from N. 7° E. to N. 15° W.), and standing nearly vertical, such dip as there is varying from easterly to westerly very frequently, and within short distances. Both the sandstones and the slates are, as a rule, rather soft, and easily weather to clays, but there are also hard bands of silicious semi-crystalline sandstones, which resist both atmospheric and mechanical disintegration well, and hence form a large proportion of the river gravels. The rock, as a rule, however, does not appear to have undergone any extreme metamorphism. Though continually searching for them I was not able to find any fossils in the formation, nor could I hear of any ever having been found. From the lithological character and mode of occurrence of the rocks, however, I take them to belong to the Silurian system.

Wherever the bedrock is bared by sluicing operations it is seen to contain many veins of quartz, some of white colour, some dull grey and very dense; these veins supply a large proportion of the gravel derived from this rock, the slates and sandstones themselves generally soon becoming reduced to clay and sand on account of their softness. Sometimes the vein quartz contains both tin ore and gold. Besides these small veins several larger quartz reefs have been found, and at one time it was hoped that Gladstone would become a goldfield, but the reefs all turned out badly on being subjected to practical trial. The most celebrated lode was that known as the Royal Tasman, close to the township. Out of a great many conflicting statements with regard to this, I incline to believe that one the truth which said that there was a small patch of auriferous stone in this lode, but that it very soon gave out and no more was found. The belief seems to be universal that the small crushings first obtained were "salted," and hence many persons regard the Royal Tasman gold as a fraud from first to last; but from the most reliable information I have been able to obtain locally from men who worked in the mine, I believe that there was really some gold genuinely got. The truth of this matter is of importance to the future of the District, for the failure of the Royal Tasman has utterly damned it in public estimation as an auriferous country, and hence prevented it from getting the attention which it fairly deserves. The Silurian formation elsewhere, at Beaconsfield, Lisle, Denison, Golconda, &c., and in Victoria has been the home of auriferous reefs, and there is rather reason to believe that such are likely to be found in the Gladstone District than that the formation should be barren. A good deal of gold is found in the alluvial gravels resting on and derived from the Silurian bedrock, as much as seven ounces to the ton of tin ore having been obtained in cleaning up the sluices used for saving the latter. The formation is therefore clearly auriferous round Gladstone as elsewhere, and all that the failure of the reefs worked should imply is simply that the right lodes have not been found yet. In some of the goldfields of Victoria there are dozens of worthless reefs for every one that is payable. Any new discovery should stand on its own merits, and not be judged by the ill success of its predecessors. In fairness to the District it is necessary to make these remarks, as there is a very general impression among the mining public that no gold can by any possibility come out of Gladstone.

Basalts.—These rocks are of no importance in the immediate vicinity of the Gladstone tinfield, but are found to the north-east of it towards the Mussel Roe and the Ringarooma Tier. I have only seen occasional stones indicating the proximity of narrow dykes in one or two other parts of the field, near the head of the Mount Cameron Water race, for example. Their presence is only noted at present because of their probably being contemporaneous with the basaltic flows between Moorina and the Billycock Tier, which overlie the oldest stanniferous gravels.

Gravel Deposits.—It has been stated above that these range in time of deposition from the early Tertiary period to the present time. There are evidences of a long-continued cutting down of the Ringarooma Valley, which has resulted in the formation of successive terraces of gravels varying considerably in their composition, and it appears to me certain that this has been due to an elevation of the land rather than to the simple erosion of the river channel. In order to understand the problem of the modes of deposition of the gravels, it is necessary to leave the immediate neighbourhood of Gladstone, and consider the evidence afforded by the mines at Branxholm, Derby, and Bradshaw's Creek. These have been reported on by Mr. Thureau, F.G.S., in 1884, (see "Report on the Stanniferous Deposits at Ringarooma," No. 99, 1884.) As shown in his map, it is certain that an old channel of the Ringarooma River ran under the basaltic plateau which extends from Derby to David's Creek. Two tributary channels joined it much in the position of the present Cascade River and Main Creek. The mines at Derby afford excellent sections of the whole formation, from which we may note, first, that the bottom of the ancient channel was at least 70 feet below that of the present river, as that depth has been proved by borings in the North Brothers' Home Mine; secondly, that the present river channel cuts across the old beds of the Cascade River and Main Creek; thirdly, that the ancient channels must have slowly filled up with fine quartz gravel, carrying tin ore, till the surface of the gravel stood quite 100 feet above the present river level; fourthly, that the gravel then became covered over with upwards of 200 feet of volcanic ashes and basaltic lava flows; and, lastly, that the existing Ringarooma River has cut its way down through all these deposits and through hard granite rock down to its present position. The river was doubtless diverted from its old course when the ancient channel became filled with streams of basaltic lava, and began to cut a fresh channel through the granite on to which it was forced, and has continued to wear this deeper and deeper ever since. From below the junction with the Main Creek the Ringarooma seems to have abandoned its old course altogether, flowing to the east of Mount Cameron, whereas the old channel lay to the westward of it. The present channel is rock-bound all the way from the Main Creek to below Gladstone, and there is no place where there is any break in the rock showing where it might have rejoined the ancient channel. The Pioneer Mine appears to be either on the edge of the old lead or in a tributary leading into it, but borings here and at David's Creek have proved the bottom of this deep ground to be far below the bottom of the present river, thus agreeing with the borings in the North Brothers' Home in showing that the ancient channel was deeper than the present one. If the old and new channels do not run into one another above Bradshaw's Creek they certainly do not join between there and Mount Cameron, as there is a ridge of granite forming a barrier all the way. The continuation of the rich Brothers' Home lead is therefore to be sought for in the low ground running down past the western side of Mount Cameron, a position in which the general topography of the country of itself indicates that it will be likely to be found. It is well known that there is very deep ground along this line.

Reverting to the sections at Derby, it is clear that, previous to the filling up of the old channel with gravel, there must have been a period when the river was engaged in cutting it out and wearing it deeper and deeper. While this was in progress no large amount of gravel could accumulate in it. The present Ringarooma River has very little fall in it; consequently, when the old river was engaged in cutting its channel, which is so much lower than the present one, it is pretty certain that the general level of the land was much higher than at present. The gradual filling of the channel was most probably the result of a subsidence of the land, causing a reduction of the grade of the river bed and consequent cessation of scour. The subsidence appears to have terminated with the eruption of the basaltic lavas, as the stream again began to cut its way downwards, showing that an elevation of the land had taken place, either with considerable rapidity, or, as is more likely, with a slow gradual movement. During this period of elevation the Ringarooma has excavated its present valley, the various terraces of gravel representing old river flats which have been cut through and left behind by the stream. The elevation of the land must have been accompanied by a recession of the seashore, resulting in the formation of successive beach terraces or raised beaches. These would be cut through by the river in its downward course, so that the terraces of gravel may often be both of river and beach formation, and it could often happen that the higher terraces were beaches while the later lower ones were purely of river origin. The variation in the character of the alluvial deposits at different levels is thus often easily explainable.

The great age of the oldest gravels in the mines at the Brothers' Home is clear from the consideration that a long period of time must be allowed for the gradual filling up of the old channel to the level of the lowest volcanic beds, for the deposition of the latter, and for the subsequent erosion through hard rock of the present Ringarooma Valley. The outflows of basalt in other parts of the colony are considered to have taken place towards the end of the Palæogene period, and there is every reason to believe that those at Derby were contemporaneous with them. No good fossil evidence of age has yet been obtained, for, though leaves were said to have been found in some of the mud-bands passed through in sinking at David's Creek, they were not preserved by the workmen or submitted to any scientific authority for identification. In the workings of the Brothers' Home Mine occasional lumps of old timber, blackened and almost converted into lignite, have been at times found, but the species of wood has not, so far as I know, been determined. Still I think there need be no hesitation in referring the sub-basaltic gravels to the early Tertiary or Palæogene period.

In my recent Report on the Beaconsfield District I referred to the alluvial gravels there, and showed that in the Early Tertiary Period the land stood at least 300 feet higher than now; that it was subsequently to the filling of the Ophir Deep Lead depressed to a level at least 250 feet lower than the present one, and that it has subsequently risen to its present position. These movements of the earth tally with the evidence

of the Ringarooma Valley as above described. When, in the Early Tertiary Period, the land stood much higher than now, the Brothers' Home and Ophir Lead channels were being contemporaneously scooped out; then came the great subsidence which piled gravels up to 250 feet above sea level on the slopes of the Cabbage-tree Hill, and caused the old Ringarooma channel to fill up; next came the basaltic flows; and since then a movement of elevation has resulted in the sweeping of the greater part of the accumulated gravels from the Beaconsfield flat, and the erosion of the present Ringarooma Valley. As the bottom of the Ophir Lead is below sea-level it may be assumed that the old Ringarooma lead also runs below sea level towards its outlet. The deposits along its course will, therefore, certainly be very wet and difficult to work.

As it seems certain that the Ringarooma lead must go to the west of Mount Cameron, away from the course of the present river, so it would also appear that the ancient stream corresponding to the modern Great Mussel Roe River ran in a considerably different position from that of the latter. This, at least, is the most probable explantion of another series of ancient alluvial gravels encountered along the course of the Mount Cameron Water-race. On the west side of the race, near the second siphon, there is a somewhat high round hill, apparently entirely composed of small, thoroughly-rounded, granitic quartz gravel. At the foot of this hill the water-race passes through some rather hard cement, composed of rounded quartz gravel also. Several springs towards the base of the hill show where water finds its way out of it. No prospecting, more than sinking one or two small pits, has been done to show if this hill is tin-bearing. It appears to me well worth trying further, as being probably portion of an ancient lead. Further down the Mussel Roe River more deep ground is encountered on F. Whitaker's section, No. 2498-87M, and to the north of it for some considerable distance. Workings on the section named were carried on some time ago, a tail-race having been brought in through soft granite from the Mussel Roe Valley. The granite bottom dips rapidly underfoot at the intake of the tail-race, hence the bottom drift could not be worked. The top drift consisted of sand, granitic quartz gravel well rounded, and well-rounded coarser quartz gravel, all mixed with a good deal of white clay, and containing a fair amount of tin ore. Borings proved a depth of 40 feet below the level of the tail-race without finding any bottom. Some distance north of these workings a deep shaft was sunk some years ago without reaching bottom. Some lignitised wood was obtained in this shaft, but it was all so crumbled that I could make nothing of the few small specimens I was able to find lying about, further than that the wood was thoroughly converted into lignite, showing the deposit to be an old one. This shaft is in a flat. To the north of it there is a gravel hill, which slopes down to the Mussel Roe River. Several springs occur on its northward slope, and I was informed by Mr. Richards, who has done much prospecting in this district, that at the foot of the hill in the bed of the Mussel Roe the ground appeared to be very soft and deep, as he could thrust a long pole a great way down into it, evidently through gravel. It would seem from this that the old lead which evidently exists in this locality crossed the Mussel Roe and went more to the north-west, a course which would connect these gravels with some other ancient deposits to be mentioned presently. I had only time for a flying visit to this part of the field, and was not able to examine it so closely as it deserves, but it seems extremely likely that there is a deep lead running through it, and very possibly connected with the hill near No. 2 siphon above mentioned. From its soft nature this deep ground is extremely difficult to prospect, but the tin ore got in the upper parts of the drift in Whitaker's workings gives good ground for believing that in the gutter of the lead very good tin ore will be found. By driving in from the northward, where the Mussel Roe crosses the lead, it is probable that the ground could be well tested. Should it prove payable an ample supply of water for working is close at hand in the Mount Cameron Water-race. This neglected part of the field is worthy of attention from men who are disposed to risk some money in the necessary, somewhat expensive, prospecting. It is beyond the resources of working miners to develop without capital to assist them, and this, I think, is what has led to its lying idle so long.

The course of this old lead after crossing the Mussel Roe is not clearly traceable, being often broken by erosion of more modern valleys, and overlaid by more recent deposits. A number of deposits of cement, however, extending from the Mussel Roe to the Aberfoyle country may, perhaps, be portions of it, though perhaps of later and marine origin. My reason for connecting them with the Mussel Roe Deep Lead is that the cement is made up of rounded granitic quartz particles similar to those of the gravels of Whitaker's workings. Further, there is reason, as we shall see, to believe that these cements are considerably older than the other gravels of the district. The cement is a rather hard conglomerate, sometimes very hard and solid, and not unlike granite in appearance; it is often mistaken locally for bedrock, and called quartz porphyry, but may be easily distinguished from the crystalline rocks by the well-rounded character of its constituent pebbles. It forms the small hill sometimes called the Edina Sugarloaf, and is also found to the north-east of it under the long siphon of the Mount Cameron Water-race, near Ogilvie's dam (58-87w.) About two miles north of the long siphon along the Water-race the latter leaves the cement or conglomerate formation and runs over slate and sandstone bed rock—(I prefer to use the name "cement" instead of the more strictly scientific "conglomerate," as the former name is better understood by miners as being wash or gravel converted into stone by some binding material.) To the north, or north-west rather, of the point where the Water-race leaves the cement I have not seen the latter for a long distance—not till the Aberfoyle country is reached, where the Brown Hill, near Tea-tree Lagoon, is again composed of it, and also some low hills north-west from the Mount Cameron Water-race Storage Reservoir (80-87w.), generally known as Matthewson's Lagoon. Between the Edina Sugarloaf and the Brown Hill there is a line of very deep ground, as to the nature of which I am in considerable doubt, whether to refer it to the same formation as the cement or to a later one. This deep ground, strangely enough, lies on the watershed between the Ringarooma and Mussel Roe Rivers, in the northern portion at any rate. The northern extension of the Mount Cameron Water-race, from about half a mile north of the crossing of the Cape Portland road, all lies upon this deep ground, which here seems to be over a mile in width. Numerous shafts have been sunk in a fine white gravel drift, some as deep as 70 feet without reaching the bottom. The character of the gravel—fine water-worn quartz pebbles derived from degradation of granite—points to a connection between this deep ground and that higher up the Mussel Roe. There is a break in the continuity of the deep ground where the road from Bell's Bridge to Cape Portland runs across its course. I have not been able to detect any sign of an old deep lead crossing this road, and it would seem that the

valley of the Pig-and-Whistle Creek has cut right down through it; if so, the bottom of the lead above this road will be above the level of the Ringarooma River, and therefore capable of drainage into it. To the south-east of this blank space deep ground is again found in the old Tamar and Garfield Companies' workings, and extending from thence to the cement near the Edina Sugarloaf. I am inclined to believe that the line of deep ground thus traced between the Edina Sugarloaf and the Brown Hill does represent the general course of an old lead, but that the upper portions of the gravels have been greatly disturbed since their first deposition. The lead, if there ever was one, was the channel of an older Mussel Roe River, cut out when the land was at a higher level than now, and filled when the subsidence took place which filled also the old Ringarooma lead. This subsidence probably brought the sea in over all the country just described, causing a re-distribution and re-arrangement of the surface gravels, though not likely to have affected the lower deposits in the gutter. While the sea was again receding in the subsequent period of elevation further re-arrangement of the surface gravels would result. The existence of the Edina Sugarloaf and the Brown Hills as hills shows that they were once parts of a much more extensive deposit, which has been greatly worn away, leaving these harder portions standing out. This wearing away in all probability took place partly during the encroachment and retrogression of the sea, and partly owing to ordinary sub-aerial agencies afterwards.

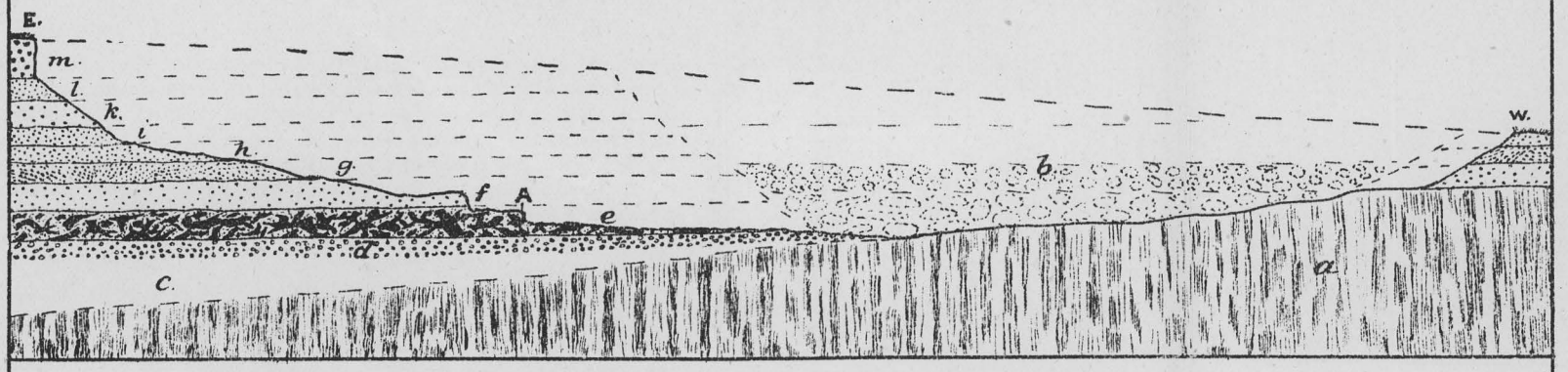
There are several things which point to the presence of the sea over these deep gravels. For example, the cuttings for the northern extension of the Government race are nearly all in a brown, somewhat ferruginous, cemented sand, often clayey. Nodules of oxide of iron, containing sand, and loose white sand, are pretty common. The sand is such as is found by the sea shore, and the cement might well have been formed in a shallow lagoon behind sandhills fringing the sea shore, as is so commonly seen along our coasts at the present day. Whether laid down in exactly this way or not, the sand shows that the sea was probably close at hand when it was deposited. In the old Martha and Tamar claims deposits of what appear to be sea sand are also found, and in the latter, more especially, there is evidence of lagoon deposition. Two sections through the workings of the old Tamar claim are appended hereto. Towards the northern and north-western end of the workings the Silurian bedrock is visible, dipping rapidly to the south east. On this lay heavy gravel, consisting of rounded and sub-angular small boulders and stones of sandstone, quartz, and dark chalcedony, the sandstone of the bedrock predominating. The chalcedony is identical with the material in a well defined lode or vein of it found on the old Eureka claim, across Harden's Ravine from the Tamar. A few stones of quartz-porphyry similar to that in Mallinson's dyke also occur, and to further show that this gravel is partly derived from adjacent granite bedrock crystals of black quartz are not uncommon. All this heavy wash has now been sluiced away, and its relation to the sands composing the walls of the excavation is not therefore so clear as if it could be seen *in situ*, but it is nearly certain that it is of later origin than the latter, and I think represents a place where the old deep ground was subsequently cut away by water action and replaced by later gravels. On working more to the south east the heavy gravel gave out, and in its stead layers of sand were encountered, which were found to surround the gravel except on the northern side, where the hillside falls away. The walls of the excavation are now all composed of sand. The layers are sometimes cemented by oxide of iron, and often contain hard cakes of oxide of iron. In parts there is a good deal of clay. Much carbonaceous matter is found through the sands; but though I searched for a long time I was unsuccessful in getting any leaves, by which the age of the deposit might be estimated. In the bottom of the present face lies a layer about 8 feet in thickness, mainly composed of fragments of timber, partly and sometimes wholly converted into lignite. Some of the wood is very little altered, and still splits freely. The fragments of timber seem to be mostly roots, logs, and pieces of heavy branches—ordinary drift-wood, in fact. They are mixed up with sand and mud and a little fine gravel. Concretions of iron pyrites are often found on the wood, and occasionally partly replace its substance. The wood has not yet been microscopically examined, but seems almost certainly that of a species of pine. In other parts of the colony, as at Breadalbane and Corra Lynn, fossil wood and lignite are found consisting mainly of coniferous tree remains, and it would seem that in Early Tertiary times members of the pine family were the commonest forest trees. The coniferous woods of this deposit themselves therefore point to its belonging to the oldest alluvial gravels, and give ground for believing that I am right in connecting this with a Palæogene Mussel Roe lead contemporaneous with the Ringarooma deep lead. This belief is substantiated further by the fact of more recent, but still old, gravel having been deposited in an eroded portion of the sand deposit as above described, and by the apparent connection of the Tamar workings by deep ground with those of the Garfield, and on to the cements of the Edina Sugarloaf. Not that I think that the Tamar sand beds were laid down by river action in the old Mussel Roe channel, but rather that they are among the very highest beds of the filling of it deposited when this part of the country was almost at sea level, and the old channel formed a shallow estuary or lagoon. The layer of drift-wood; the sharp sea sand; the prevalence of ferruginous and carbonaceous stains; the false bedding often seen in the sand,—all point to an estuarine or lagoon formation. Above the sand beds there is a layer about 11 feet thick of fine quartz gravel, which most probably indicates a further advance inland of the sea, and complete submergence of the lagoon deposits.

The old Martha workings in one place show a face about 20 feet deep, composed of very small quartz gravel and sand, the latter fine sea-sand as in the Tamar claim. The bottom bedrock is dipping away from the Ringarooma Valley, more towards that of the Pig-and-Whistle Creek. As these beds of sand in the Martha are quite 60 feet lower than the similar ones in the Tamar, they are not likely to belong to the same horizon, but they also give evidence of the former presence of the sea running up much along the line of the supposed Mussel Roe lead.

The sands in the old Tamar mine were found to contain a little extremely fine tin ore, which, though not itself nearly payable, bears witness to the presence of tin in the rivers running into the sea at the time of its deposition, and thus gives promise of better results when the true river channels are discovered.

The deep gravel and sand formation extends from the Tamar workings, round the head of Harden's Ravine, to the old Garfield Company's workings on Section 2077-87M. These, again, are connected by a spur which appears to be entirely composed of fine quartz gravel with the high-level dam of the Esk Com-

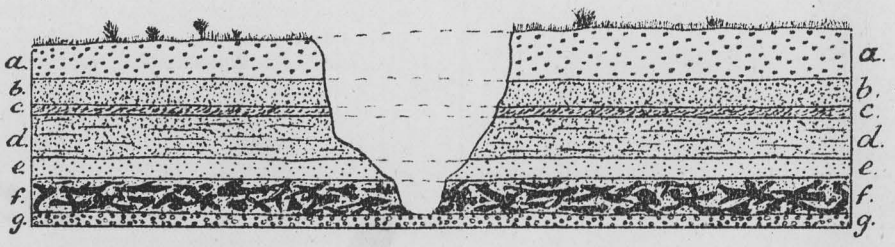
SCALE. 60 FEET TO AN INCH.



LONGITUDINAL SECTION ON LINE BEARING N.77°W.

THROUGH THE OLD TAMAR WORKINGS.

a. Silurian bed-rock. b. More recent gravels, sluiced away. c. Possible deep ground. d. Bed of small gravel. e. Bed of lignite and sand. m. Fine quartz gravel, somewhat cemented. f. g. h. i. k. l. Beds of loose and cemented, often ferruginous and clayey, sand.

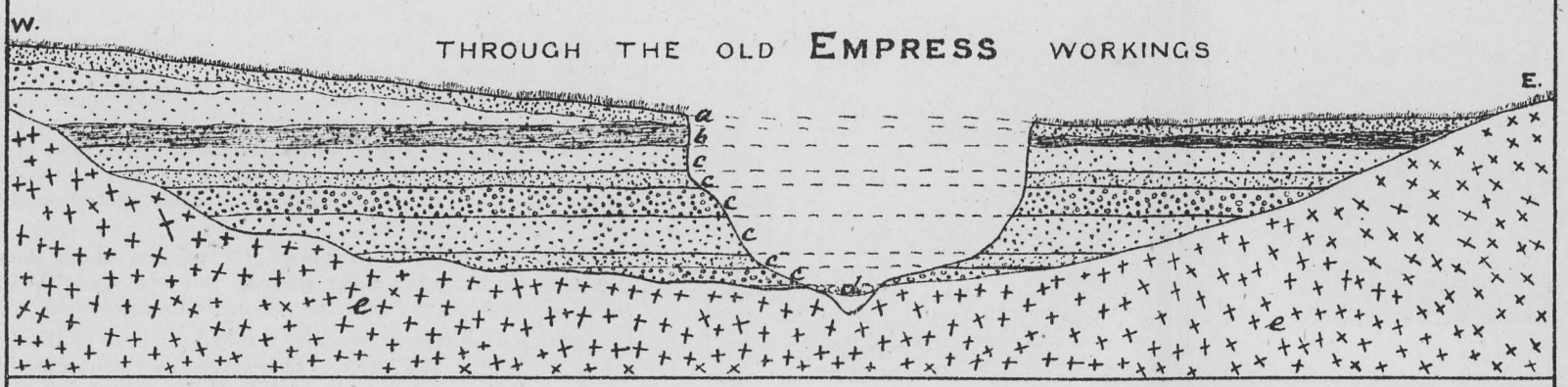


CROSS SECTION OF THE ABOVE AT POINT A.

a. Cemented rounded fine quartz gravel. b. Sand, in parts pretty strongly cemented by oxide of iron. c. Clayey whitish sand, in places red iron cement. d. Brown sand generally cemented with oxide of iron, with numerous hard cakes of oxide of iron: in some parts this bed is not cemented at all, but is simply loose sand. e. Loose whitish sand with small quartz pebbles. f. Lignite mixed with sand, mud, and gravel. g. Layer of small pebbles.

CROSS SECTION

THROUGH THE OLD EMPRESS WORKINGS



a - Surface cement crust. b. Clay c.c.c. Layers of more or less fine gravels and coarse sand. d. Heavy wash, now all sluiced away. e. Granite bed-rock.

pany. The excavations for this show no bedrock, but only fine rounded quartz gravel and yellowish-brown sandy clay. A somewhat large cutting between this and the Eureka dam shows the Silurian bedrock not far from the surface, and south of the Esk dam solid granite crops out, so that in this part there does not appear to be a great depth of gravel. The cutting shows the following section in the face :—

	Feet.
Surface soil and ferruginous cemented clayey fine gravel of rounded quartz pebbles and granitic quartz grit	3
Very clayey layer, containing gravel	2
Coarse brown sand, sometimes false-bedded, with occasional small gravel in horizontal layers	11
Coarse gravel of sub-angular fragments of the Silurian bedrock and angular and sub-angular quartz	1
Silurian slate and sandstone bottom.	

The coarse gravel resting on the bottom seems to have formed only a very small proportion of the whole mass, and to have been immediately derived from the bedrock below, though a few stones from lodes in the granite and black crystals show that part of it was transported from neighbouring granite bottom. The Silurian bedrock is again seen in a cutting at the back of the Eureka dam. Between the Garfield and Tamar claims, however, numerous shafts have been sunk without reaching bottom, generally not to greater depths than from 20 to 40 feet on account of the soft running nature of the fine gravel and sand passed through, which was often regular quicksand. In the eastern side of the Garfield workings the Silurian bedrock is visible, but towards the outlet the ground has not been bottomed, and large quantities of sand are encountered. It seems likely, therefore, that the deepest ground lies east of the Tamar and west of the Garfield cuttings. The average depth of the latter is from 6 feet to 16 feet. The following section was observed as a representative one, in one of the faces :—

	Feet.
Surface soil	1
Ferruginous cemented sand	1
Fine well-rounded gravel, with one bed of coarser gravel near the middle of the layer	7
Small very well waterworn quartz and quartzite gravel, with softened slate fragments and stones of Silurian sandstone	$2\frac{1}{2}$
Coarse sand and fine gravel, rather cemented, not bottomed	3

The beds of fine gravel and sand make and thin out again in short distances. The beds of sand often show false bedding. The Garfield workings are about 40 feet higher than the top of the Tamar face. These gravels were doubtless laid down when further subsidence of the land had sunk the Tamar beds well under water and brought the sea further up the old river valley.

It will be seen from the above that neither the Tamar nor the Garfield workings give direct evidence of belonging to the same formation as the cements of the Edina Sugar-loaf and the Brown Hill, but they go to show that deep ground exists along the line connecting these places, and that this deep ground was filled by the advance of the sea inland, which must have been at its furthest when the basalts of the Brothers' Home were being poured out. Should the reference of the cement deposits to an old Mussel Roe River bed be correct, it is clear that the river valley would be the most favourable place for the accumulation of deep masses of gravel during the advance of the sea, hence it is somewhere under these marine gravels that we should look for the ancient river deposits. The theory has enough plausibility in it at any rate to be worth testing by borings, though these would be difficult of execution on account of the quicksands.

The deep ground between the Pig-and-Whistle Creek and the Aberfoyle would, probably, be the lower part of the old Mussel Roe Valley, but mostly filled with marine gravels. The old river channel, with its probably richer gravels, is, most likely, covered to a very considerable depth. The shafts sunk in this part of the district have nearly all gone through a succession of fine quartz gravel and sand beds poor in tin. If my theory of these being the ancient river gravels, washed over and over again by marine action, is correct, very little tin could be expected in them until the deeper unmoved river deposits are reached. These, also, it might be presumed, would not be so rich as higher up in the leads nearer to the granite formation. Beyond noting the ferruginous clayey sands found in the northern extension of the Mount Cameron water-race as of probable estuarine or lagoon formation, as above mentioned, I have not been able to get much evidence about the deep ground in this lower part of the old valley. The Lochaber workings possibly belong to this formation. The upper beds are very like those of the Tamar, and the bottom appears to be getting deeper towards the north west, thus sloping towards the main area of deep ground. The following section was noted in these workings :—

	feet.
Soil and cemented gravel	2
Sand, very fine gravel, and clay	15
Rather fine quartz gravel	10
Coarse angular sandstone and quartz stones and gravel	5
Brown cemented fine gravel	10
Bottom of Silurian slate.	

These workings have produced very fair tin, mostly from the heavier lower wash. This often contains somewhat large quartz boulders and pieces of waterworn quartz porphyry. The upper beds are in horizontal layers. The pebbles are mostly of quartz, but some of Silurian sandstones and of quartzite. Black quartz crystals are not uncommon. As these workings lie very low down, the outlet of the tail-race being not more than, perhaps, fifteen feet above the Ringarooma River, it seems possible that they are approaching much nearer to the old lead, which may account for their much greater richness in tin as compared with the higher Tamar and Garfield gravels. I am inclined to refer the Lochaber deposits, however, rather to the marine series than to the true river gravels of the old lead.

If the sea had once covered all the Gladstone district to a height above the Esk dam, as assumed in the foregoing, it would, probably, have left traces of its presence in other parts than those mentioned. It may be said at once that no shells or purely marine organisms have been found to clearly prove the former presence of the sea, but when we consider that most of the deposits preserved were originally shifting sands and gravels, and that these are generally very poor in organic remains, and that only small patches of the marine beds have yet been laid open to view, it is not at all surprising that shells have not been found. Other evidence is, nevertheless, available. This is best obtained in the terraces on the north slope of Mount Cameron. These are completely cut off from the Ringarooma Valley by high spurs of granite running down from the mountain, so that they cannot have been laid down by the river even when at a much higher level. The Mount Cameron Company's claim, and those of Mr. L. Petersen, afford information as to these terraces. The longest and largest one is that in which Petersen's principal workings are situated. It extends right along the foot of Mount Cameron for over two miles, about parallel to the range, and may be located on the map of the district by the water-races running along it. The top of this terrace preserves a pretty uniform level of about 90 feet above the township of Gladstone. There are, however, remains of two still higher terraces—one near the middle of Section 916, 130 feet above Gladstone, and the other, a small patch only, about six chains S. 5° W. from Wilson and Petersen's old dam (W.R., 45), 190 feet above Gladstone. As the township is about 270 feet above the sea, gravels are, therefore, found on the slopes of Mount Cameron to a height of 460 feet. The character of the terrace gravel is considerably different from that of the modern river gravel, and would itself indicate a marine origin as more probable than a fluviatile one. The pebbles consist mostly of hard quartz, thoroughly rounded and polished by long continued attrition, and generally rather egg-shaped than in the flattened disks most common in river gravels. Besides the quartz there is often in some of the terraces a considerable amount of quartzite derived from the old Archæan rocks, which is a very ancient metamorphic sandstone now often sub-transparent, but still showing the constituent grains and stratification planes. Wherever this is found it is most thoroughly waterworn. It is a very hard stone, and must have required an immense amount of rolling about to wear it into the shapes found. This rock does not occur in the newer river gravels, except in very small quantity, and even when it is found it is so much more thoroughly polished than the rest of the gravel that it is plainly derived from older gravels which have been washed down into the river bed. The successive terraces from the highest down to the present river level are characterised by a marked diminution going downwards of the percentage of quartzite in the gravels. The highest terraces contain the largest proportion of it, and the least of gravel such as is now being brought down by the river. As it does not appear to be brought down at the present time by the Ringarooma, it is improbable that the quartzite occurs *in situ* anywhere up its valley, and if so the occurrence of it in the higher terraces must be attributed to some other source than the river. Exactly similar quartzite is found in the old gravel deposits which are met with at intervals along the road from Scottsdale to Moorina, in some also near Lilydale, and on the top of the Sandhill, near Launceston. All these old gravels doubtless are remains from the time when the land was much lower, and the sea beach reached to points now far inland. The quartzite pebbles have been derived from the Archæan conglomerates and quartzites found at places along the north coast of the Island, and spread all along the beaches by the action of the waves.

It is noteworthy that the beach terraces on the north slope of Mount Cameron are much more free from these pebbles than the other high marine terraces up the Ringarooma Valley. This is most likely due to the high granite spurs which separate these localities. These spurs would form capes round which the drift beach gravel could not easily pass. Petersen's workings show the wash of the North Mount Cameron terraces to be composed almost entirely of *débris* from the granite of the mountain, fine quartz gravel and sand, coarse heavy lumps of vein quartz, and crystals of black quartz. The heavy gravel on the granite bottom is often not much waterworn, while the higher lighter gravels show extreme attrition. As there are no large streams on the north slope of the mountain to round these gravels, we must conclude that their shape is due to ceaseless washing backwards and forwards on the sea beach. The beds of gravel lie fairly horizontal, but generally slope slightly seaward. The granite bottom confirms the view of the beach formation of these terraces, being uneven but not furrowed into regular gutters as when cut out by running streams, and sloping gently seaward. The bottom when stripped shows much the appearance presented by a flat granitic beach of the present day. The distribution of the tin ore is in accordance with this theory, being in flat layers through the drift, and not concentrated in the furrows of the bottom; indeed, these have been found to be so generally poor that they are often not cleaned out in working. The beach being a natural buddle has served to concentrate the tin ore just as black iron sand is often seen concentrated on our coasts at the present time, and the layers of ore thus formed have become covered with further deposits of gravel, and so preserved. A very similar occurrence is seen in the black sand beach-leads of the West Coast of New Zealand, where layers of black iron sand containing gold are worked in what is without any doubt an old beach formation, and on the beach at Charleston and elsewhere "beach-combers" make a living by working similar beds forming at the present day.

Taking a line northward from Petersen's main workings it is found that a succession of terraces parallel to the large one, and at successively lower levels, extend seaward for some distance. Between each terrace and the next lower one the granite bottom often crops out. Some of the layers of gravel are very shallow, and none seem to be very deep. These terraces represent successive stages in the retrogression of the sea-shore.

I have dwelt at length on the facts which prove that the sea was at one time washing the flanks of Mount Cameron and extending far up the Ringarooma Valley, because this is the key to the problem of the manner of formation of all the terrace gravels right up the latter. It is easy now to understand that as the land rose and the sea receded terrace after terrace of gravel was left behind. These have since been so cut away by the water running over the surface that only fragments of them now remain. The highest terraces were probably of purely beach formation, but as the sea retired the waters of the Ringarooma began to carve into the ground, and the lower terraces are in most instances of river origin. As above pointed out, the percentage of quartzite in the gravel gives a clue to its origin, whether beach or river.

In consequence of their mode of deposition we should expect to find somewhat similar gravels at the same elevation above sea level. I append a table of heights of various points in the district noted by me with an aneroid barometer, which shows approximately which deposits are at or about one level. The newer river terraces can of course only be correlated by taking the fall of the river into account as well as the absolute elevation. As a matter of fact the various gravel deposits do agree with considerable exactness with those at corresponding levels elsewhere through the district, thus substantiating the theory of their formation above advanced. We may now classify the gravels as follows:—

(I.) *Palæogene.*—A. *Older River Gravels*, including cements of Edina, Sugarloaf, and Brown Hills.

B. *Newer Marine Deposits*—Tamar, Garfield, and Lochaber claims.

(II.) *Neogene.*—A. *Older Beach Gravels*—Petersen's terrace, Mount Cameron Company's terrace, Colossus terrace, Enterprise terrace.

B. *Mixed Beach and River Gravels*—Scotia, Aberfoyle, and Gladstone terraces.

C. *River Gravels*—Simpson's terraces at South Mount Cameron, lowest terraces in the neighbourhood of the Ringarooma River.

1. *Palæogene*—A *and* B, *Older and Newer River and Marine Gravels.*—These already have been considered at length, and need not be now reverted to. They are the filling of the old Mussel Roe lead as first laid down by the river and afterwards by the sea. One point of some importance has not yet been mentioned, namely, that boulders of the cement or conglomerate frequently occur in the later gravels of the Neogene period, showing that the old wash had been already hardened and subjected to erosion when the latter were being laid down. The much greater antiquity of the cement is, therefore, evident. I have observed boulders of the old cement in some workings up Smith's Creek at South Mount Cameron, some distance above Mr. John Simpson's house, in J. W. Brown's old workings near Ogilvie's Bridge, in Ogilvie's Edina claim, in the Scotia Company's workings, and in Nobes's claim at the Aberfoyle, and was informed that it was frequently met with in other claims. In these workings it is a very hard conglomerate, composed of small rounded quartz pebbles, cemented by a siliceous cement into a very solid stone, which rings when struck, and breaks with a flinty fracture. In Brown's and the Edina claims it is found in large tabular masses, sometimes five or six feet square and one to two feet thick, resting loosely on the granite bedrock, but surrounded and sometimes underlaid by the gravel. Most of these large tables are smooth and polished on the upper surface, and have been considerably worn there by water. The polished surfaces appear to have received more of the siliceous cementing material than the rest of the mass, and often there is a sort of thin transparent siliceous skin or gloss on the surface. The appearance is such as would result from the passage of a solution carrying dissolved silica over fine quartz gravel, loose or somewhat cemented. The solution would at first penetrate freely into the porous stone, and so cement the particles strongly together, but as, owing to this action, the mass would become denser, and less easily penetrated, after a time only the surface layers would be permeated by the solution, and finally it would flow over the surface without going into the now hard rock at all. It is difficult to imagine how these large flat angular blocks of conglomerate could have been moved far from where they were formed, and I incline to the opinion that near Ogilvie's Bridge they are almost *in situ*, and are fragments showing that the old cement formation was once much more extensive. In the Scotia claim the pieces seen were much waterworn, and had probably been transported a long way from their original position.

II. *Neogene*—A. *Older Beach Gravels, Mount Cameron Company's Section, No.* 100.—On this ground a considerable patch of wash belonging to the older beach gravels has been worked out with payable results. It formed a shallow capping, not probably more than 10 feet deep anywhere, on the top of a ridge between the Fly-by-Night Creek and a small branch of the Mount Cameron Creek. The bottom is of slate, much decomposed to clay in the upper portions. Tin ore was often found in these upper clays, evidently having sunk down slowly into them, just as gold has often been found in the pipeclay (decomposed slate) bottom of many Victorian gravel deposits. All the tin ore obtained in this claim was extremely waterworn. The slate bottom is rather uneven, but flattish on the whole, and shows no true gutters eroded by running water. The wash lies in horizontal layers, and is composed of somewhat angular and subangular pieces of quartz and Silurian sandstone, with some well-rounded pebbles of quartz and quartzite. There are also occasionally rounded boulders of a brecciated rock, consisting of angular fragments of Silurian bedrock, cemented by black and white chalcedonic quartz. This may perhaps be of contemporaneous origin with the conglomerates of the Edina workings. On the whole the heavier material of this terrace appears to have been derived chiefly from the bedrock upon which the gravel rests, and not to have travelled very far. A good deal of coarse sand and fine gravel occurs enclosing the heavier stuff. The deposit is covered with a somewhat ferruginous hard cement which has protected it very much from erosion. Below the principal workings in the small creek the bedrock changes to granite, and at the contact of this with the sandstone and slate formation there is a small lode of silicified granitic matter, about three feet wide. Stones from this or a similar lode are found at times among the wash. It may be mentioned that the gravels of this claim contained a good deal of gold, as well as tin ore. The main body of gravel has all been worked over, and at the time of my visit the only mining going on was being done by Chinese, who were stripping the surface soil and putting it through sluices. Under this soil patches of cement were occasionally visible, and there is a possibility that on breaking through some of these some heavier gravel left in depressions of the bedrock may be found, though there does not seem to be much hope of getting any extensive patches.

At the easternmost corner of this section, and on that known as the Fly-by-night claim (1130M) adjacent to it, there is rather a thick deposit of hard ferruginous cemented sand and fine gravel, from two to four feet thick. Some of it is very black, as if originally formed in a swamp or lagoon. Under it lies a little quartz wash containing tin. The cement itself contains tin, but would require crushing, as it is too hard to be broken up in the sluices. Several small holes have been sunk through the cement here and there, and one considerable excavation has been made, but it has not been considered worth working. It is probable that if a series of trenches were run through the cement several underlying patches of gravel would be discovered.

Petersen's Claim (Section 823).—A very large excavation has here been made in a part of the long beach terrace formerly mentioned. The bedrock is granite, lying pretty flat, but with a slight slope seawards. The wash is mostly well water-worn small quartz gravel, with coarser subangular pieces of quartz on the bottom, all evidently derived from granite rock. The following section of one of the faces was noted:—

Fine gravel, somewhat cemented with clayey and ferruginous matter...	7 feet
Fine quartz gravel, a little cemented, white in colour, showing false bedding.....	5 feet
White clayey sand.....	½ foot
Wash in nearly horizontal layers of fine and somewhat coarse quartz gravel.....	12 feet
Heavy subangular quartz stones.....	½ foot
Granite bottom.	

This has the reputation of having been a very profitable claim, and the large extent of the workings all made by one man pretty conclusively prove that such has been the case. Tin is easily seen in many places in the wash. Lying rather high up on the mountain there is difficulty in getting constant supplies of water for working. Could a copious and never-failing supply of water at high pressure be brought on to this ground it ought to pay remarkably well. This claim may be taken as proving the general value of the long terrace lying to the westward from it, on which very little work has been done for want of water. Several test shafts have been sunk at intervals along this terrace, and very satisfactory proof obtained of there being both quantity and quality of tin-bearing gravel.

The higher terraces above mentioned are of small extent, but are said to be worth working when water can be obtained for them, which is but very seldom.

The lower terraces running parallel to the main one are of considerable extent, and some work has been done on parts of them with fairly payable results. A considerable excavation has been made on the boundary between Sections 1047M and 2286-87M, about 2½ chains south-east from the westernmost corner of the former. The face presents the following section:—

	Feet	inches.
Surface soil and white sand like sea sand.....	1	6
Ferruginous and clayey cemented coarse quartz sand.....	4	0
Tough white clay with much sand in it.....	4	0
Wash, quartz gravel with good tin, finer towards the top, coarser towards the bottom of the layer.....	1	6
False bottom of clayey sand, which changes to gravel in parts of the same horizontal layer.....	1	0
Layers of finer and coarser quartz gravel with a little sandstone, and lenticular clayey sand patches.....	8	0
Granite bottom.		

In this opening a junction of the granite and Silurian formations is seen, the latter slightly overlying the former. Very fair tin has been obtained, and there appears to be a large quantity of gravel ahead to be mined.

It appears to me that these beach terraces along the north slope of Mount Cameron are among the most important gravels in the district. There is a large extent of unworked ground which has given good prospects, and when water can be got a large amount of tin ore will probably be obtained. The obstacle which has prevented their being worked is that all the available water supplies have been secured by the Mount Cameron Company, the owners of the Fly-by-Night claim, Petersen, and one or two others, who require all that they can get for their own claims.

Enterprise Claim (Section 128.)—A shallow patch of ancient wash forms the top of a flat-rounded small hill on this section. The workings cover a large area, but are of small depth. The wash is composed of well rounded gravel, mostly quartz, but also in part quartzite. The bottom rock is granite. On the top of the hill I did not see the bottom, and am not certain if the workings have reached the bedrock. There appears to be a considerable amount of gravel yet to be worked, but the top ground being very high there is difficulty in getting water on to it. The claim has been very rich in the past.

Colossus Claim, South Mount Cameron.—I am inclined to class the gravels of this claim with the beach deposits on account of their occurring in a large flat even layer rather than in leads or channels, and from the gravel being mostly composed of very well-rounded quartz pebbles with only a few of hard sandstone. The same sort of gravel is found at intervals along the road from South Mount Cameron to Gladstone at much the same height as the Colossus terrace, so that the deposit must have covered a very considerable area. The Colossus Company have opened several excavations in the gravel, working it by means of water pumped from the Ringarooma River. I do not think that the ground will pay for mining so long as water has to be thus so expensively obtained. The results of working up to date are not encouraging. Owing to the flatness of the bedrock on which the gravel rests, difficulty will be experienced in getting in tail-races as the work of stripping proceeds.

B. *Mixed Beach and River Gravels.*—These deposits are characterised by containing a varying proportion of flattened shingle derived from the river, and were probably laid down on beaches in an estuary at the mouth of the river. They are intermediate between the purely beach deposits and the true river terraces. The majority of the gravels close to Gladstone township belong to this class. They lie in fairly horizontal layers on comparatively flat but uneven bottoms, which do not, as a rule, show well defined stream channels, and which, therefore, appear more likely to have been cut into their shape by marine than by river action. A section from the township of Gladstone to Bell's Bridge would show a succession of steplike layers or terraces of gravel with the bedrock cropping out between each pair. None of the layers

of gravel appear to be very deep, ranging from three or four feet up to ten or twelve feet on an average, though sometimes as deep as thirty feet. A well in the yard of the *Gladstone Hotel* is said to have gone through thirty feet of wash. None of the highest gravels appear to have been thought worth working, though numerous prospect holes have been sunk. These top terraces are largely composed of small well-rounded quartz and quartzite pebbles, with a good deal of clay and sand. The highest workings close to the township are those on Butler's section, on the slope towards the Mount Cameron Creek. At the time of my visit a start had been made here, and an excavation about 12 feet deep worked out. There was a good deal of coarse gravel in the face, covered by a layer of finer gravel mixed with clay. The first clean-up was disappointing, not being payable. Whether the ground will improve remains to be seen.

The next terrace that has been worked is what is known as the Syndicate's claim, belonging to Messrs. Carlinn, M'Kimmie, and Matthewson. Here a great deal of work has been done with, I understand, payable results. The wash has been of an average depth of from 10 to 15 feet, the bottom being very uneven. There is a top layer from 2 to 3 feet thick of ferruginous cement, composed of fine quartz gravel well rounded. Below this comes the wash consisting of layers of finer and coarser well rounded quartz, quartzites, and jasper gravel. In the bottom layer there is a good deal of broken Silurian bedrock, and sub-angular quartz. The next terrace below the Syndicate's claim is that in which the workings of E. R. Groves, T. Morrissey, and Jas. Ogilvie (now, however, part of the Syndicate's claim) are situated. There are considerable depths of gravel in this terrace, which has proved to carry tin rather unevenly, some of the workings being payable and others poor. There is yet much untried ground in this terrace, and it will, no doubt, all be worked in time. Ogilvie's face is about 18 feet deep. There is a top layer of three feet of brown quartz-grit cement, then a succession of layers of finer and coarser gravels lying fairly horizontal. Quartz and quartzite make up the bulk of the pebbles in the upper drift, but near the bottom there is a good deal of rounded and sub-angular Silurian fragments from the bedrock and quartz from the veins in it.

On the Mussel Roe Road, north of Ogilvie's Bridge, there are two large terrace-workings, executed by C. A. Ogilvie and J. W. Brown respectively. A little to the north of Ogilvie's workings there are some gravels seen on the roadside that may belong to the older and higher Enterprise terrace. In Ogilvie's workings the wash averages about 10 feet in depth, and is overlaid by from 4 to 6 feet of sandy clay. It consists of thinnish horizontal layers of quarts, quartzite, and metamorphic slate and sandstone gravel of rather small size interspersed with granitic grit or coarse sand. The deepest part of the ground is furthest away from the outlet, and a new tailrace has had to be brought in in order to get fall to work with. This deposit is reported to have given payable returns, and extends over a large area, so that there will be work for a long time in sluicing it away. It may possibly be connected directly with the Enterprise gravels, though I believe it is a lower terrace.

The granite bedrock crops out between these workings of Ogilvie's and J. W. Brown's, which latter lie just north of Ogilvie's Bridge. The cutting is from 30 to 40 feet deep in the deepest parts. The wash is coarser than in Ogilvie's face, and the river gravels predominate over the beach quartz and quartzites. Indeed, this deposit might be as well classed with the river gravels proper as with the present division. The large blocks of cement found here have been already mentioned. These workings have been abandoned and the ground given up, so it may be presumed that it was unprofitable. This is unfortunate, as there is still a large quantity of gravel in this terrace if it could be made to pay.

Lower down the river, and on the east side of it, is James Ogilvie's Edina claim (section 1251M). Both in height and in the character of the gravels in it, this corresponds very well with the terrace worked by C. Ogilvie above described.

Mention should not be omitted of the old Empress claim in the list of gravels of this division. The workings are situated on sections 677 and 164, and run nearly due north across a ridge separating Harden's Ravine from the low country east of Bell's Bridge. Forming a gulch as they do at right angles to the course of the spur, they afford a striking example of the difference in the course of the present and ancient streams. The gravels were laid down in a saddle between two granite hills, and have been cut away on each side by the modern watercourses, until only a small portion is left as a ridge filling the old saddle. There is said to have been a sort of channel or gutter along which the workings were carried, but it must have been quite a shallow one, for the gutter now seen has evidently been cut out by sluicing, and the beds of wash run off nearly horizontally in layers on each side. A cross-section of the workings is given to show this. On the west side the surface shows gravel for about 10 or 12 chains, right to the old fluming on the top of the hill from which the pipes for the Tamar workings were led. On the east side the granite crops out about 4 chains from the cutting. It appears to me that this ground has been abandoned too soon: for though the bottom doubtless rises on both sides, on the western side there is room for other gutters like the one worked, and the total quantity of gravel left untouched must still be very large. It may have been prospected, but I saw no traces of the pits if there were any. The wash is in horizontal layers; the heavy rich gravel having been in the shallow channel aforesaid. That which now composes the walls of the cutting is nearly all fine gravel and coarse granitic sand. The gravel is well-rounded quartz for the most part, and the sand shows false-bedding frequently.

The claims on the Scotia terrace also appear to have been formed by the joint action of sea and river rather than by either separately. The gravel is composed of about equal proportions of quartz, quartzite, and Silurian sandstone, all much rounded. The workings average 10 to 15 feet in depth. On the bottom (Silurian) there is coarse gravel with a good deal of subangular quartz. The bedrock bottom runs very flat and without definite water channels, and slopes gently to the north-west. The wash is overlaid by 4 feet of sandy clay and 2 feet of surface cement. The Scotia Company and J. W. Brown have opened six faces in this terrace with payable results. The terrace is very extensive, and should give work for many years to come. The flatness of the bottom and consequent trouble in getting fall for the tail-races is the principal drawback to future success.

Further down the river we come to the sections held by the Aberfoyle Company, Messrs. G. B. B. Elliott, Nobes, and others, on an extensive area of gravel generally spoken of as the Aberfoyle country. The bedrock here is granite. The wash is, as a rule, much smaller than at the Scotia, but otherwise very similar, and has decidedly more the appearance of beach gravel than of river. Most likely these deposits were laid down at the mouth of the river where it debouched upon a wide flat beach. They are generally not very deep where opened by working. The tin obtained in this part of the district has been very patchy, and on the whole the ground does not appear to be very rich, though good enough to ensure being worked. Like all alluvial ground where there is large quantity of somewhat poor gravel, this should be worked with a copious supply of water so as to move the stuff rapidly. There appears to be a disposition on the part of owners to economise by using little water and that of low pressure, but all sluicing experience has gone to show that this is false economy, and that it pays to use much water and the greatest available pressure, even though the first cost of pipes to bring in a high pressure supply is very considerable. Another direction in which it appears to me that much money and labour are lost is in the bad location of tail-races. All over the field numbers of expensive tail-races are seen, now out of use, and superseded by others still more expensive. Numbers of pits should be sunk all over the ground to be worked so as to ascertain the shape of the bottom, and the trail-races should be designed in the first instance to command the whole of the deposit, either from the first, or with comparatively small expense from time to time in deepening them. At present they seem to be taken in, in a very happy-go-lucky style, without any system.

The workings on Nobes's Section, at the Aberfoyle, show a very interesting section, which, as work proceeds, will very likely throw much light upon the subject of the old Palæogene deep ground. A tail-race has been constructed running north-west from a swampy river flat, evidently an old angle of the Ringarooma River, about east from the Brown Hill. The race passes through sandy clay containing numerous rounded large boulders of the Palæogene quartz-conglomerate, on one of which I noticed very faint leaf markings, not recognisable as to species. Higher up the race a black stiff clay is encountered, coloured with carbonaceous matter, but not yielding me any leaves. The cement boulders seem to be in the bottom layers of this clay and below them. Some are very large and heavy. The clay forms a false bottom on which the superincumbent gravels are being worked. These are nearly horizontally bedded, but have a slight dip south-east or away from the Brown Hill. The section seen in the face was the following:—

	feet	inches.
Surface soil	0	6
Layers of gravel, clay, and sand, but mostly sandy clay	10	0
Coarser gravel	0	6
Coarse sand with some clay	4	0
Coarse gravel and sand	2	6
Fine sand, much false-bedded, with occasional layers of wash	10	0
Black stiff clay false-bottom.		

A party of Chinese were working this at the time of my visit, and had just had a payable clean-up of their sluice. The conglomerate boulders belong to the same formation as the Brown Hill and the cements near Matthewson's Lagoon.

C. *River Gravels.*—These are characterised by the predominance of river shingle, consisting of flattened pieces of Silurian slates and sandstones. The quartz in them is generally sub-angular. Rounded quartzite pebbles are of rare occurrence. No hard-and-fast line can be drawn between these and the last division, some of the lower gravels of the latter and higher of this being very similar, the Mary claim, for example, being very like parts of Groves and Morrissey's terrace in character of gravel. These deposits were laid down in the bed of the river when it flowed at a somewhat higher level than now.

Near Gladstone the claims belonging to this class all lie on the east side of the river, with the exception of Mr. James Ogilvie's workings, which are in flat ground close to the river, and practically in part of its present channel. The terraces on sections held by F. Whitaker, east of Bell's Bridge, the Mary claim, Bromby and Dickenson's section, and Rushton and M'Kimmie's claim, near the Scotia ground, are all composed of river gravels. The Mary claim has been a very good one, and is still getting good tin. In the old workings there appears to have been difficulty in getting the tail-races low enough to work the back parts of the terrace. Rushton and M'Kimmie also appear to have a good claim. Besides their workings on the terrace they have opened up one of the river flats, but could not get drainage without using a hydraulic elevator. At South Mount Cameron the terraces worked so successfully by Mr. John Simpson near Smith's Creek, and the Red, White, and Blue claim, on the other side of the Ringarooma, are also river wash.

Two attempts have been made to work the gravels lying alongside the present river and under flood level, the most enterprising being that of the Long Reach Dredging and Tin Mining Syndicate at South Mount Cameron. This Company, at large expense, erected at their claim a Priestman dredge for raising the gravel. The plant was at first encumbered with a number of elevators and appliances of one sort and another, which were thrown out when the machinery got to practical work. Without going into details the following general description of the plant will be of interest as showing what can be done by this method of working. Two large punts were built, one of which carried the engine and crane of the Priestman dredge, and the other the trommels for separating out the coarse stones, the sluice-boxes for washing the finer stuff, and a Robey portable 12 h.p. engine, which drove the trommels and worked a centrifugal pump which raised the water required for washing the gravel. The engine for the Priestman dredge was of eight horse power. The grabs were made with teeth which fitted closely together when closed, with alternating pick and chisel points. The punts were moored to stumps of trees on the bank, and could be easily moved by hauling on the wire rope moorings into any desired position. The material raised by the grabs was dropped into a hopper, and thence into the trommel, into which also was discharged the water from the centrifugal pump. The trommel had holes $\frac{3}{4}$-inches in diameter, and was set on an inclination of one in nine when working, the punt being ballasted so that it would remain level when the hopper was full of material. The fine gravel passing through the trommel passed over sluice-boxes or ties, where it was raked by a workman, and thence by a swinging launder into the tail-race on the bank, and so into the river.

The heavy stones from the trommel discharged themselves into trucks, and were run into the river by manual labour. During the four months that the dredge was at work an excavation was made into the flat alluvial deposit forming the bank of the river about 250 feet long, 50 feet wide, and 15 feet deep, nearly 7000 cubic yards of material being handled, thus averaging about 70 cubic yards per day. Mr. Bewley, who was in charge of the operations, estimated the performance at 100 tons a day, or 600 tons a week, which agrees closely with the above estimate, a cubic yard weighing about a ton and a half. The cost per week for working expenses was £25, or tenpence per ton. Heavy trees and stumps in the surface soil added greatly to the expense. Under favourable conditions the expense might be reduced to sixpence a ton, but I do not think that any lower estimate could safely be made of the probable expense of this method of working in any of the tin districts of this Colony. The first cost of the plant is heavy, and though it works very efficiently and treats a large quantity of material, I feel pretty sure that the expense of running it is too great to make it profitable under any ordinary circumstances. A machine that will handle quantities of gravel at a cost not exceeding 1½*d.* to 2*d.* a yard is what is required for most tin-bearing gravels. The Dredging Company were particularly unfortunate, only obtaining about a ton of tin ore all the time. This, probably, is not a fair sample of the wash obtainable in the river bed: it is more likely that they were unlucky enough to begin work in a particularly poor place. It may be mentioned that there was some gold in the tin ore obtained, but I did not learn how much. The plant is now being dismantled and sold off.

The other attempt to work the river flats is being made by Mr. Jas. Ogilvie, with a hydraulic elevator of very primitive construction. The upraise pipe in use was simply ordinary thin galvanised iron tubing, and for a throat-piece a bit of cast-iron water-pipe was being used. The material was being raised 12 feet vertically by means of a pressure of 150 feet of water, brought across the river in pipes from the Mount Cameron Water-race. About three heads of water were being used for elevating, and two heads for sluicing. With the head available, not nearly so much water would be required for the elevator if it were of good construction. Mr. Ogilvie is to be congratulated on his enterprise in trying this method of working, which is one new to the district, though long in successful use in New Zealand and California. The hydraulic elevators are without doubt the most suitable machines for working the low-lying gravels by the side of the river, and the bed of the stream itself when the water is diverted by wing-dams, or taken away in flumes. A great deal of the difficulty experienced in the higher terraces also in getting rid of the tailings could be obviated by their use to elevate the gravel a few feet so as to permit it to be sluiced back into old workings. The tail-races would then only require to have enough fall to carry the finer tailings and waste water. There is not much printed information available as to the working of these machines, so I have collected as much as seemed desirable, and append it to this Report.

Water Supply.—The prosperity of every alluvial mining district depends more than anything upon the sufficiency or otherwise of the supply of water for sluicing purposes. The country round Gladstone is not well situated for being easily supplied with water, the only really high ground in the vicinity being the Mount Cameron Range, which, however, is not of sufficient extent to furnish constant streams of water. Between Mount Cameron and the Blue Tier, where never-failing supplies might be got, there is much low country, so low as to necessitate either very long lines of pipes or very high flumes in order that water might be brought over it to command the higher gravels. By the construction of the Mount Cameron Water-race the eastern side of the Ringarooma River has become possessed of a good supply of water, though even this race does not command the high deep ground near the old Garfield claim. On the Gladstone side of the river the owners of claims have still to be contented with the intermittent supplies available from storm waters which are not nearly enough for requirements, or with the water raised from the Ringarooma River by the Esk Company. Every small depression of the ground where a little rain-water can be caught and stored, and every little streamlet has therefore been secured by one or another claim-holder, and in wet weather a good deal of work goes on with this water. The disadvantages of this way of working with very small streams of water and much manual labour are very obvious when compared with the hydraulic method, and the only compensating advantage is that the water is cheap. In most cases, however, a steady supply of water of fairly high pressure would give the owner more profit, even if he had to buy it, than this intermittent working can. In order to get constant supplies of water various pumping plants have been at one time and another erected to force it from the Ringarooma River up to the claims. The Tamar and Scotia plants have been dismantled, and the only ones now at work are those belonging to the Esk and Colossus companies. The Esk machinery is very ingenious, the river being utilised to drive the pumps. A dam about 29 feet high has been put across the stream, acting as a weir in flood-time, and at ordinary times diverting part of the whole of the river into a flume which carries the water on to an overshot water-wheel, 20 feet in diameter, and with 18 feet of breast, said to be able to develop 97 horse-power. The wheel works reciprocating horizontal plungers twenty inches in diameter and with a stroke of 8 feet. These are fed with water directly from the flume overhead. A balance-bob is provided for overcoming the dead point in the revolution of the crank working the plungers. The plant labours under the serious disadvantage that it is liable to be submerged by floods, and even when there is only a heavy fresh in the river the disturbed water below the weir partly chokes the free working of the wheel. Water is forced to the Eureka and Esk dams on the eastern side of the river, and to a point on much the same level as the Eureka dam on the Gladstone side. Water raised by this plant is also brought across the Ringarooma from the eastern side by a line of pipes on a rough suspension bridge to the Syndicate's claim. The cost of working the machinery is about £30 a month, without counting cost of repairs of damage done by floods. All the claims near Gladstone township are now supplied with this water, which is sold for 18*s.* a sluice-head. In one case I noticed a piece of very bad policy. In order to save pipes the water was allowed to run downhill in a rough race a vertical distance of between 60 and 70 feet before being taken into pipes and led to the working face. The party were working with about 30 feet of head when they might have had 100. The difference in quantity of work done by the latter head would very soon pay for the pipes, especially as the gravel was somewhat clayey and hard to break down.

It has been proposed to bring a branch of the Mount Cameron Race across to the Gladstone side to serve the claims there. The branch would leave the main race at a point to the south-east of the Edina Sugarloaf, bend round the south side of the latter, and be carried by a siphon across the Ringarooma Valley, then round the shoulder of Ogilvie's Sugarloaf, and so to Gladstone, the total length being a little over five miles. The cost of a race to carry 20 sluice-heads of water is estimated at under £4000. There is no doubt but that such a race would be a great boon to the district. The end of the race at Gladstone is well above all the payable gravels, and it would command the whole of the ground between the township and the Ringarooma at Bell's Bridge. Here there is still more ground to work than has yet been taken out, and, worked vigorously with all the available water, there is probably at least three years' constant work. The principal other tin-bearing ground commanded would be the large terraces near Ogilvie's Bridge, worked by Ogilvie and Brown. The Enterprise terrace is, unfortunately, too high to be reached. On the two terraces there is work for the whole of the water for quite three years, as far as I can judge without actual measurement. There is thus work in sight for the water to be brought across for at least six years, in which time the race ought to have paid for itself, and given a fair interest as well. By the end of that period it is probable that the extensions of the workings on the east side of the river would require all the water that the main race is able to supply. In bringing this branch race over to Gladstone, the Government would, of course, be entering into competition with the Esk Company, who are now supplying most of the claims; (not, however, those near Ogilvie's Bridge.) It is not my province to enter into the question of the desirability of the State pursuing such a policy; but, leaving the Esk Company's claims to consideration out of account, there is no doubt in my mind as to the expediency of the work.

Another plan for supplying the Gladstone claims with water has been often suggested, and is worth consideration. It would have the great advantage of being a high level supply, and commanding the terraces on the north slope of Mount Cameron, which cannot be reached by either the Esk water or that of the Government race. On the other hand, there is great doubt as to whether a constant supply could be maintained all the year round. This scheme is to construct a large dam in the Deep Valley, at the head of Campbell's Creek. This valley lies pretty flat, and receives the drainage from the ridges all round, the catchment being about a square mile or rather more. It seems possible to construct a very large reservoir here with comparatively small expense, the sides of the valley coming together towards the outlet. The bottom is solid granite, which would afford an excellent foundation, and material for the dam could be cheaply got from the steep mountain sides. I have not been able to get any records of the rainfall at Gladstone, but that at Boobyalla is recorded in the Official Meteorological Reports. In 1888 there were 88 wet days, and a total rainfall of 19·86 inches. The maximum fall in any one month was in June, 4·23 inches; and the minimum in March, 0·10 inches. In 1889 there were 103 wet days, and a total rainfall of 36·04 inches, the maximum monthly fall being 10·39 inches, in November, and the minimum 0·67 inches, in February. The rainfall on the top of Mount Cameron is greater than at Boobyalla, but these figures will serve as some guide as to the quantity that could be collected. The average rainfall per square mile is 680,000 cubic feet, or 19 sluice-heads per day of 24 hours for each of the 191 wet days in the two years. If every drop of water were conserved this would only give a daily supply of five sluice-heads (equal to 15 sluice-heads for the working day of eight hours). The dam would have to be large enough to store the entire rainfall of any one month, and would be better to be able to take three months' rainfall. This might be taken at a maximum of 15 inches, which would require for the dam a capacity of 34,848,000 cubic feet, or 217,295,000 gallons. I doubt very much if this size of dam could be made without unreasonable expense, even though the ground is so very favourable for storage of water. A tolerably accurate survey would be required to test the possibility of this scheme. There is no doubt that a large reservoir in the Deep Valley would furnish a very good supply of water during the wetter months, but I do not think it could be relied on for a constant one. It might perhaps give enough water to enable the high gravels to be worked, and for this alone it deserves to be critically considered.

Prospects of the District.—My examination of the District was too short to permit of making surveys to determine the relative amounts of worked and unworked gravels, but I have no hesitation in saying that there is still far more ground untouched than has yet been sluiced, and that there are many years' work in sight still. The terraces near Petersen's claim and in the vicinity of the Scotia have hardly been more than commenced upon, and the large area of gravel at the Aberfoyle is still practically untouched. The Lochaber claim is working into still deeper ground, and will take years to work out. When the shallower gravels are exhausted there is still the deep ground to fall back upon. The value of this is unproved as yet, but it is likely that parts of it at least will be worth working. Finally, the District is not done with as a producer of alluvial tin until the bed of the Ringarooma River itself has been worked out. Various trials have been made of this in various ways with results less encouraging than might have been expected, still there can be no doubt that the bed of a river like the Ringarooma, which passes through tin-bearing country all along its course, and receives innumerable creeks which have all borne tin, must contain large quantities of ore It is a large ground-sluice, and cannot fail to have much tin concentrated in it. I cannot believe but that systematic and well-directed work on it would be remunerative.

It is a matter of national importance to ascertain the course and value of the old Ringarooma and Mussel Roe leads. The experience of the mines at Branxholm, Brothers' Home, and Bradshaw's Creek has demonstrated that the Ringarooma lead is especially a most valuable one, and every effort should be made to trace it further, and test it by borings. This is work which requires money, and is beyond the means of local claim-holders, and I would therefore invite the attention of mining adventurers to it, with every confidence that they will find it an unusually promising and legitimate enterprise. The Mussel Roe lead is more problematical, but also deserves attention. I would recommend that a more detailed geological survey of both these leads should be made, and that series of borings should be executed in places indicated by the survey as most likely to give reliable information as to the deposits. I am strongly of opinion that most valuable results would follow from such borings.

I have, &c.

The Secretary of Mines, Hobart. A. MONTGOMERY, *M.A., Geological Surveyor.*

TABLE of Approximate Heights above Sea-level of various points in the Gladstone District, determined by Aneroid Barometer.

(These heights are only rough approximations, and must not be relied on as accurate, having been taken with only one barometer, and during a period in which the barometer was very unsteady.)

	Feet.
Ogilvie's old dam, Deep Valley	679
Crossing of creek, Deep Valley, track to Sapphire Creek	612
Highest terrace gravels, near Wilson and Petersen's dam	460
Top of saddle, Mussel Roe Road, near Ogilvie's Sugar-loaf	450
Esk Company's dam	414
High gravel terrace, section 916, north of First Sugar-loaf	400
Top of Garfield terrace	396
Ridge of gravel between Eureka and Esk dams	387
Embankment of old Star dam	378
Petersen's terrace	364
Bottom of workings 6 chains south of Eureka dam	360
Top of old Tamar face	358
Top of old Enterprise workings	351
Gravel on road near dredging plant, South Mount Cameron	346
Top of Esk Company's pipes, Gladstone side of river	342
Eureka dam	338
Bridge on road at Old Star Creek	336
Top of ridge between Empress workings and Ringarooma River	333
Top of Edina Sugarloaf	329
Top of proposed Government siphon across Ringarooma River (Gladstone end)	328
End of proposed Government branch race	304
Terrace of gravel on road near Campbell's Creek	319
Top of Colossus terrace, South Mount Cameron	312
Bottom of Petersen's large excavation	310
Terrace of gravel on Dredging Company's section	308
Top of Pioneer Company's workings, Bradshaw's Creek	290
Top of C. A. Ogilvie's large excavation near Ogilvie's Bridge	288
Top of old Empress workings	279
Top of Mount Cameron Company's workings	279
Floor of *Gladstone Hotel*, Gladstone	270
Old shaft in deep ground, Upper Mussel Roe	266
Mallinson's workings on old Eureka claim	266
Terrace of gravel, Smith's Creek, South Mount Cameron	265
Top of spur between Mount Cameron and Fly-by-Night Creeks, on track	261
Gravel ridge, near Waterman's cottage, Scotia	257
Top of terrace, section 2286-87M, worked by Chinese and Petersen	256
Floor of Mr. John Simpson's house, South Mount Cameron	250
Top of Brown Hill, Aberfoyle	247
Bottom of C. A. Ogilvie's workings in creek near his house	245
Bottom gravels in Mount Cameron Company's workings	245
Top of Red, White, and Blue terrace, South Mount Cameron	245
Bottom of excavation, Ogilvie's Edina face	243
Outcrop of granite bedrock on road between C. A. Ogilvie's and J. W. Brown's workings	243
Intake of Scotia Branch, Mount Cameron Water-race	239
Top of Matthewson, Carlinn, and M'Kimmie's workings, 2195-87M	238
Bottom of workings, old Empress claim	234
Top of Scotia Company's gravels, near water-race	234
Bottom of cement layer, Fly-by-Night workings	234
Bridge over Smith's Creek, South Mount Cameron	234
General level of country westward of Lochaber claim	216
End of Mount Cameron Water-race, turn-off to lagoon	216
Ringarooma River, at outlet of Colossus tail-race	207
Top of Matthewson, Carlinn, and M'Kimmie's workings on 1282M	207
Top of Scotia Company's working face	198
Top of J. W. Brown's workings, near Ogilvie's Bridge	198
Top of Whitaker's workings, north-east of Bell's Bridge	198
Ringarooma River, at outlet of Simpson's tail-race, South Mt. Cameron	193
Top of old Martha workings	192
Top of Groves's workings, section 1188M	191
Top of Lochaber working face	189
Ringarooma River at Priestman Dredge, South Mount Cameron	187
Old Portland quartz claim, Mussel Roe	171
Top of Mary Company's terrace	171
Ogilvie's Bridge	171
Top of Rushton and M'Kimmie's terrace, Scotia	162
Bottom of workings, old Martha claim	162
Bottom of workings, Mary claim	158

Lowest wash on Groves's terrace	158
Ringarooma River, at Ogilvie's Bridge	149
Top of Esk Company's water-wheel	145
Bottom of Lochaber workings	144
Bell's Bridge	136
Flat near James Ogilvie's house	123
Outlet Lochaber tail-race, in Pig-and-Whistle Creek	122
Ringarooma River, at Esk water-wheel	118
" " crossing of Syndicate's pipes	116
" " Bell's Bridge	114
" " Rushton and M'Kimmie's cage	108
" " " " tail-race	107
Pioneer Hotel	326
Moorina Post Office	371
Gravels on Scottsdale Road, near Mount Stronach	371

(These last two heights are not likely to be nearly correct, but are given for what they may be worth.)

HYDRAULIC ELEVATORS.

As these very simple and highly efficient machines are not well known in this Colony, I have collected together from various sources a few facts about them which will be useful to mine-owners. They are largely used in California and New Zealand for raising gravel from low-lying situations to such a height as to permit of it being sluiced. For their most satisfactory working both high pressure and large volume of water are required; but these once obtained the cost of working is very small, thus giving these machines a great advantage over most others that can be used for raising gravel.

From an able article on "River Mining," by R. L. Dunn, in the ninth annual report (1889) of the State Mineralogist of California, the following description, and Figure 1 attached hereto, are taken:—

"*Deep-bar Mining by Elevators.*

"Where it is possible to obtain large heads of water under considerable pressure, the mining of deep bars (except where covered by slides) and extended areas of river-beds that have been opened by fluming, is most economically and rapidly effected by means of what are called hydraulic elevators or lifts. This style of plant has already been incidentally referred to in connection with the Golden Gate and Horseshoe Bar mines." (These references are quoted below.) "These elevators consist of a wrought-iron upraise pipe or barrel, of diameter dependent on the vertical lift and water-pressure available, those at present in use being from 11 inches to 20 inches in diameter. For convenience they are usually set on a 60-degree inclined framing, though the nearer vertical they are set the better they work. The length of the elevator is, of course, determined by the slope it is set on and the vertical lift made. The extreme lift now in operation is 89 feet, though I do not consider that the limit of practical efficiency by any means. The lower end is slightly flared out, set in the bottom of the pit open, and with the nozzle of the pipe, carrying water from the pressure-box from 200 to 500 feet above, projecting into it, and in the line of the elevator. A short distance above the nozzle a throat section is set in, narrowing it from 11 inches to seven and one half to ten, dependent on the amount of wear on the throat section, which, of course, can be replaced when worn too large. The upper end of the elevator is flared out a little, and discharges into a sluice-box with riffles for saving gold. The action of this elevator is by the stream of water coming from the nozzle of the pipe and forced through the elevator by the head from the pressure-box. This stream going through the throat section with its tremendous velocity creates a very strong suction, which lifts water, sand, gravel, and boulders from the pit and discharges them into the sluice, where the gold is caught and the tailings discharged on the dump. For the proper action of the elevator a large amount of water is necessary in the pit all the time. This water is first employed in ground sluicing, piping top gravel and waste off the pay gravel, and in washing the latter in the pit in small boxes with a sluice-head. Large boulders are handled by the derrick, or barrows, and piled in the pit on cleaned bedrock, and the fine material, after screening by a grizzly, goes into the elevator sump or pit and is lifted out of the mine. Where the elevator discharges into the sluice, the latter is covered by a heavy framing lined with green pine and liveoak logs, on which the water and gravel impinge before dropping into the sluice.

"For pumping water, and sand and fine gravel if necessary, another form of elevator is designed and used. In this, the foot of the elevator, placed, if desirable, 30 feet above the sump, is a solid pear-shaped casting, the nozzle screwing into the bottom, and discharging through the throat at the upper end. The suction pipes from the sump enter the sides of this pear-shaped casting.

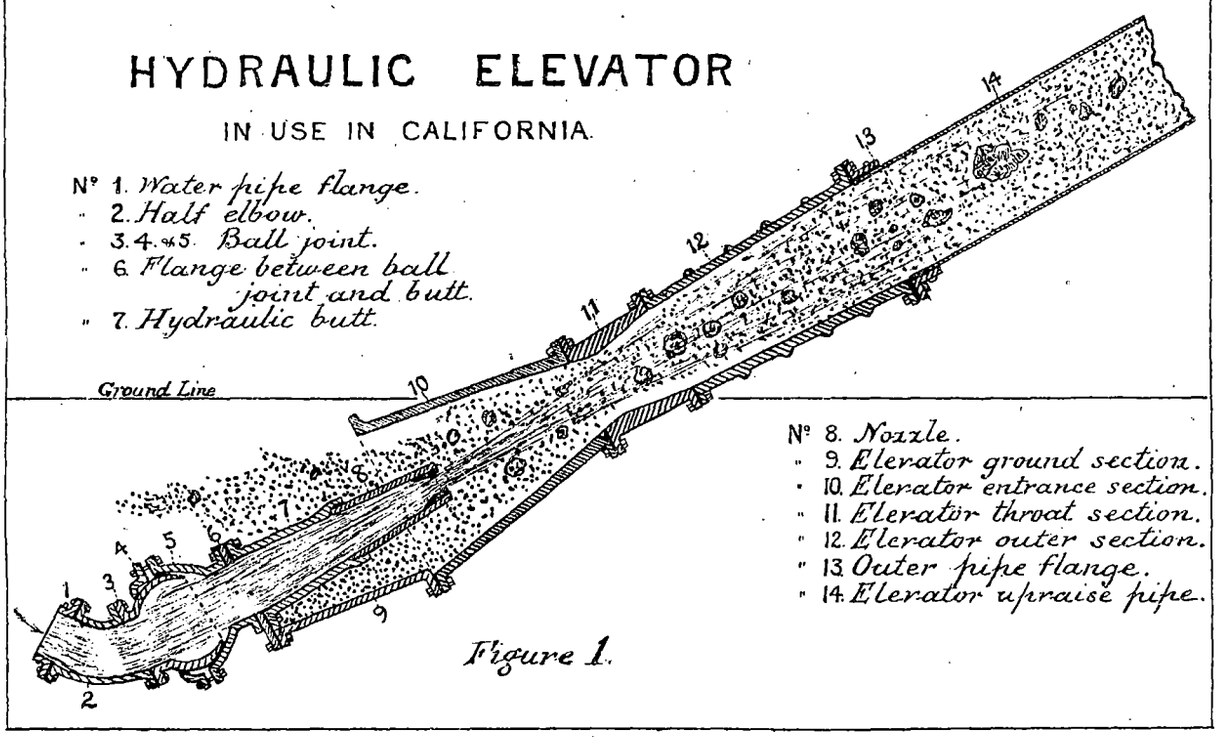
"This class of machine is exceedingly efficient for pit mining. With it the problem of drainage is practically reversed, and the difficulty is not so much to get the water out of the pit as to get sufficient in to mine with. Quicksands and barren top dirt offer no serious obstacles to thorough mining, and the machine does the work of more men than could be practically worked on the same ground, and in a fraction of the time.

"The Mammoth Bar Mine in Placer County has been successfully exploited by means of an open pit, working through elevators, after unsuccessful attempts for 30 years to mine the same ground by drifting, and it is to this mine more than to any other that the credit of demonstrating the utility of these machines is due. The pit excavated in 60 feet depth of sand and gravel is now very large, and has increased the facility of working. Instead of sweeping all the top dirt through the elevators to the dump, it is sluiced back on worked-out ground, and only the pay gravel washed into the sump, at a considerable economy of water and time. This mine uses 400 inches of water under 450 feet head for its elevators; but its

HYDRAULIC ELEVATOR

IN USE IN CALIFORNIA.

N° 1. Water pipe flange.
" 2. Half elbow.
" 3. 4. & 5. Ball joint.
" 6. Flange between ball joint and butt.
" 7. Hydraulic butt.



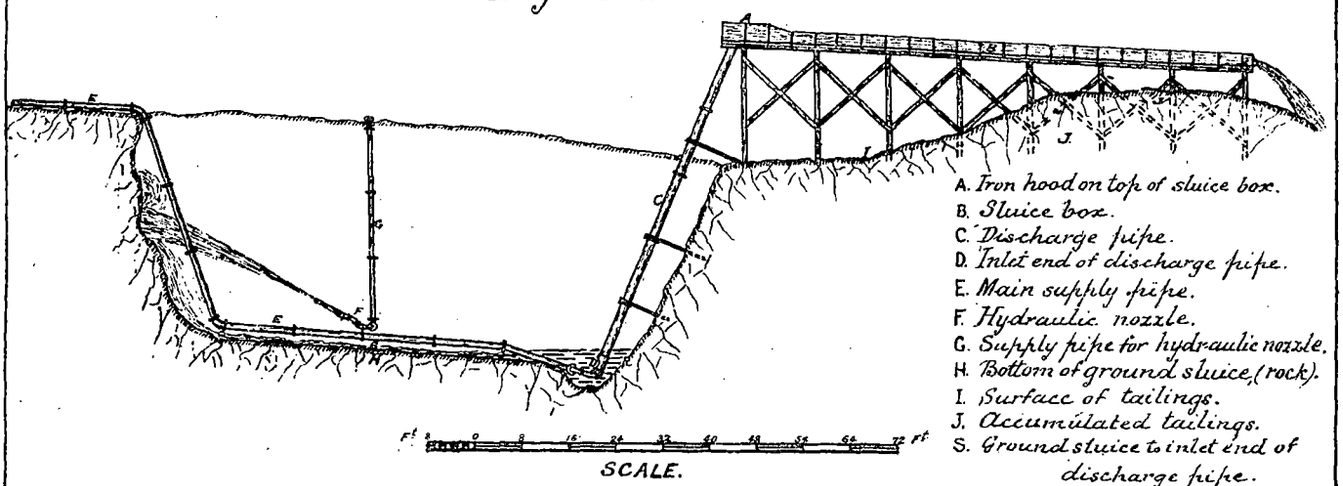
N° 8. Nozzle.
" 9. Elevator ground section.
" 10. Elevator entrance section.
" 11. Elevator throat section.
" 12. Elevator outer section.
" 13. Outer pipe flange.
" 14. Elevator upraise pipe.

Figure 1.

PERRY'S ELEVATOR

AT GABRIEL'S GULLY, N.Z. (1886).

Figure 2.



A. Iron hood on top of sluice box.
B. Sluice box.
C. Discharge pipe.
D. Inlet end of discharge pipe.
E. Main supply pipe.
F. Hydraulic nozzle.
G. Supply pipe for hydraulic nozzle.
H. Bottom of ground sluice (rock).
I. Surface of tailings.
J. Accumulated tailings.
S. Ground sluice to inlet end of discharge pipe.

SKETCH SECTION OF THE CAST IRON BOTTOM PIECE OF THE GABRIEL'S GULLY ELEVATORS (1891.)

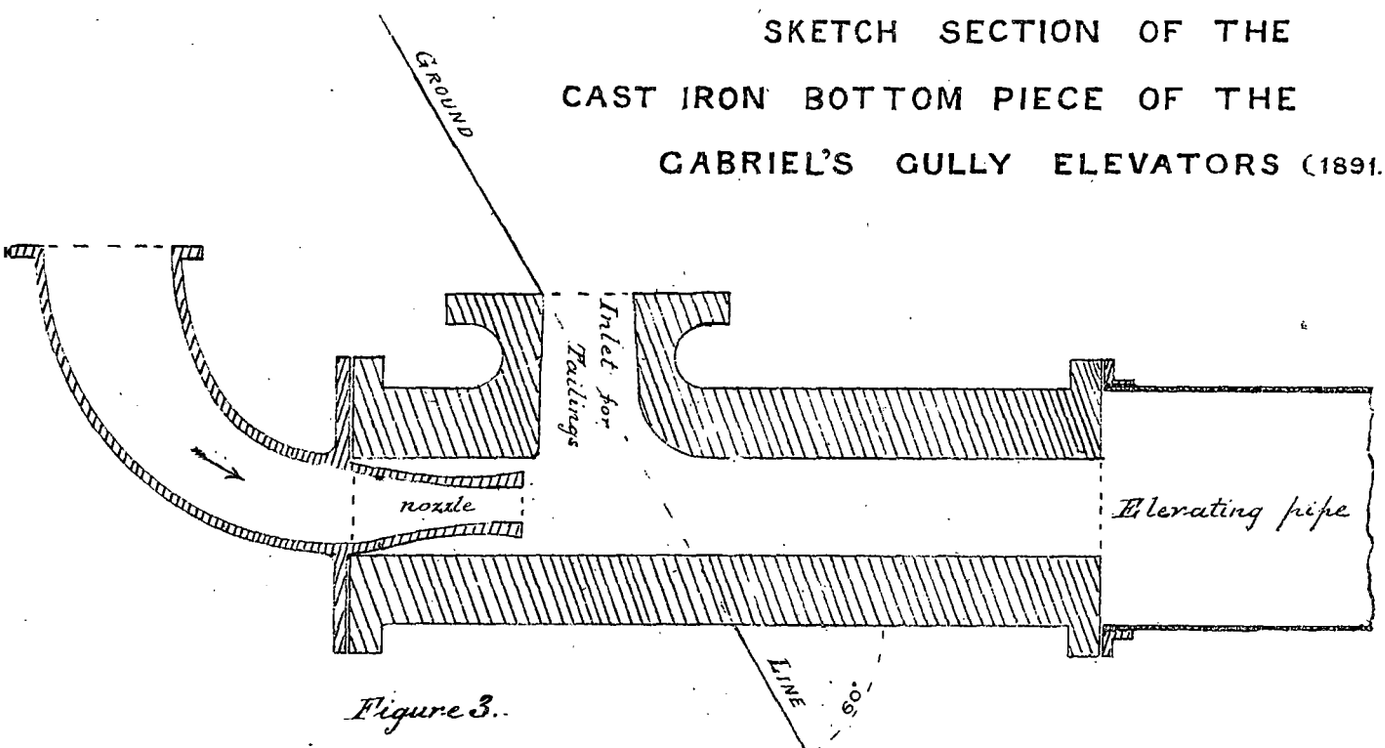


Figure 3.

1891

experience has demonstrated that larger elevators and a larger supply of water would be still more economical, as the cobbles now moved by hand labour slowly and expensively could be then handled by the elevator rapidly and cheaply."

The references above alluded to are as follows :—

Golden Gate River Mine: "The pumping plant consisted of two elevators, two Chinese pumps with boxes 3 by 28 inches, and a centrifugal pump. The lift for the pumped water was 28 feet. The elevators had columns or barrels 11 inches in diameter, with a 10-inch throat, this latter proving too large for good work. They were operated with 275 feet head of water from the Palermo Ditch. One of them, with a $2\frac{1}{2}$-inch nozzle, used 175 inches of water; and the other, with a 3-inch nozzle, took 208 inches."

Horse-shoe Bar River Mine : "The mass of sand and gravel overlying the pay gravel on the bars is so great that pitting by the usual method of hand labour is both too uncertain and too expensive to be advisable. The method of work approved and decided on by the owners of the property is the use of hydraulic elevators run by water under high pressure."

In another article in the same valuable Report, on "The Auriferous Gravels of California," the writer, Mr. John Hays Hammond, also refers to hydraulic elevators, and gives a photograph of those in use at the North Bloomfield Mine. "The capacity of this elevator is, according to Superintendent Radford, 2400 cubic yards per 24 hours. The gravel is elevated 87 feet vertically. One thousand three hundred miner's inches of water are required under a pressure of 530 feet. In addition to elevating the gravel, the 800 inches of water used in piping the 2400 cubic yards of gravel is also raised with the gravel." In a footnote, however, Mr. Hammond adds :—"Since writing the above I learn from Mr. L. L. Robinson, the President of the North Bloomfield Company, that the hydraulic elevator has been abandoned because of the great expense attending its operation. He thinks, however, that for heights up to about 40 feet the elevator would work to advantage under favourable conditions as to cost of water, &c. The company is making other experiments in this direction at present."

In reducing the Californian miner's inch to Tasmanian "sluice-heads," the former may be approximately estimated as $1\frac{1}{2}$ cubic feet a minute, while the latter are $24\frac{1}{2}$ cubic feet a minute. A Tasmanian sluice-head is therefore about 16 miner's inches. The expense of the enormous volume of water required for the North Bloomfield Company's large elevator, and the rapid wear of the elevator pipe, appear to have been the principal causes of giving up its use.

Elevators are much used in New Zealand in the sluicing districts of Otago and the West Coast. They were first introduced by Mr. J. R. Perry at Gabriel's Gully. "The Handbook of New Zealand Mines," published in 1887, gives opposite page 32 a diagrammatic sketch of the apparatus which is reproduced herewith (figure 2.) The following description is given by Mr. H. A. Gordon, Inspecting Engineer of the Mines Department, in his Annual Report of 1886 on the Mining Industry of New Zealand, page 73 :—

"A large paddock is excavated out of the bedrock, and into this paddock the whole of the material is sluiced from the face. An upright or slightly inclined pipe, 15 inches in diameter and 47 feet long, is placed from the bottom of this paddock to a flume which extends for about two chains, and empties into another small tank where a second inclined pipe of same diameter is placed, having a vertical height of 37 feet; thence the whole of the water and sluiced material goes into a large flume, and is carried away as in an ordinary sluice-box, having ripples and false-bottoms to save the gold, the tailings being deposited in the bed of Gabriel's Gully. By these two lifts the whole of the water and tailings are raised a vertical height of 84 feet. To accomplish this about 20 sluice-heads of water" (the New Zealand sluice-head is 60 cubic feet a minute) "are required, having a head from 350 to 400 feet. Five sluice-heads are employed in breaking the cement and sluicing it into the lower paddock. Then seven and a half sluice-heads are employed to raise the water and tailings to the first flume, 47 feet in height, and another seven and a half heads are employed to raise it from the second tank or paddock up to the main sluice-box, 37 feet in height."

In his report of 1890 Mr. Gordon gives further information about the Gabriel's Gully elevators, as follows :—"At the time of my visit there was a scarcity of water and only two nozzles were at work. The bottom elevating-pipe lifted the material 14 feet into a flume 84 feet long and three feet wide, and then there was another elevating-pipe at the end of this flume which lifted the material 60 feet into another line of boxes, which carried the tailings clear of the paddock and workings and deposited them in the bed of the gully. . . . . There are two elevating-pipes at the upper paddock; the lower one lifts the material about 12 feet and the upper one 25 feet, and the tailings are deposited in the old worked ground." . . . . In reference to the quantity of material lifted, the manager stated that when he was lifting the material 87 feet 8 inches in two lifts, namely, one 62 feet 8 inches and one 25 feet, in 85 shifts, comprising 680 hours, he moved 26,920 cubic yards, which would be equal to 40,380 tons; and the gold obtained was 115 oz. 11 dwt. 16 grs., representing a value of £433 8*s*. 9*d*., and the expenditure in connection with this work was £198 18*s*. This, therefore, shows that the quantity lifted to the height mentioned was equal to about 59·4 tons per hour, and that the value of the material was equal to about 2·58 pence per ton, and the cost of the work was equal to about 1·18 pence per ton. The quantity of water used was 350 inches—$8\frac{3}{4}$ sluice-heads—with a head of 450 feet on the 62 ft. 8 in. elevating-pipe, and 400 inches—10 sluice-heads—with a head of 375 feet, on the 25 ft. pipe. The quantity of water used on the nozzle for bringing the material to the well where the bottom elevating-pipe was placed was 150 inches—$3\frac{3}{4}$ sluice-heads—with a head of 375 feet.

In regard to the amount of work done with the quantity of water used, it appears doubtful if the data supplied are reliable, inasmuch as there is no comparison between the percentage of power employed to lift the material in the 25 ft. elevating-pipe and that used to lift the material in the pipe 62 ft. 8 in. To analyse this, it means that in the bottom 25 ft. pipe 10 sluice-heads of water was used under a head of 375 feet, which, disregarding friction entirely, would be equal to 426 theoretical horse-power, and the quantity of

material lifted, being 59·4 tons per hour, is equal to 2218 lbs. lifted to a height of 25 feet per minute, or 55,450 lbs. a foot high per minute. The quantity of water lifted is equal to the quantity used for elevating *plus* the quantity used in nozzle for breaking down, namely, 10 + $3\frac{3}{4}$ = $13\frac{3}{4}$ sluice-heads, or 1,289,062 lbs. lifted a foot high per minute, thus making the total weight to be lifted 1,344,490 lbs., which is equal to 40·7 theoretical horse-power, and shows that 9·46 per cent. of the power is absorbed in friction. Again, the quantity of water used in lifting the material in the upper elevating-pipe is $8\frac{3}{4}$ sluice-heads under a head of 450 feet, which is equal to 447 theoretical horse-power. The weight lifted equals the quantity of water formerly used in the lower pipe *plus* the quantity used in the pipe in question, namely, 10 + $3\frac{3}{4}$ + $8\frac{3}{4}$ = $22\frac{1}{2}$ sluice-heads, or 84,375 lbs., together with the weight of the solid material, namely, 2218 lbs., lifted to a height of 62 ft. 8 in., or 5,429,372 lbs. lifted a foot high per minute, which is equal to 164·5 theoretical horse-power, and shows that in this case only 1·71 per cent. of the power is absorbed in friction. Taking into consideration the loss of head due to friction of water in pipes, the quantity of water given for the work done by the upper elevator is too small, or else the quantity given for working the lower elevator is too great. (The percentages of absorbed power in the above calculation are of the actual work done, not of the total theoretical horse-power. In other words, the power lost in the first case is 9·46 times the power used, and 1·71 times in the second case.)

It will be seen from the above calculation, and from other instances that might be cited, that a great deal has yet to be learned as to the amount of head and quantity of water required to lift a given weight of gravel to a given height. Practice seems to vary very much in this respect, and no good working formula seems yet to have been made out.

In a private letter Mr. Gordon has been good enough to give me a few further particulars :—

"The elevating pipe is generally set on an inclination of from 55° to 60°, and the flange on the upper end is bolted on to the sluice-box. The pipe is made of steel plate of from 14 to 16 B.W.G. rivetted, with angle iron flanges every 16 feet, that is, the pipes are made in about 16 feet, or sometimes 18 feet lengths, with angle iron flanges at each end, and are bolted together with ½-inch screw bolts. The bottom pipe is generally made of cast iron about 4 feet long in the following manner." (See Figure 3 attached hereto.) "The pipes are generally about from 12 inches to 15 inches in diameter inside. The bottom pipe has a liner inside made of hematite iron. When the liner is new it is only about 6 inches inside diameter, that is, it has $4\frac{1}{2}$ inches thickness of metal, and wears down until the internal diameter has about 9 inches diameter. I will give you the dimensions of the Blue Spur elevators. One of them is 83 feet long, set on an angle of 55° 30′ = 68′ 5″ vertically. The quantity of water used for elevating in this pipe is 500 inches, equal to $12\frac{1}{2}$ sluice heads, with a pressure or head of 450 feet. This lifts about 56 cubic yards of tailings per hour, and also 300 inches of water (7·5 sluice-heads), which are used in the bottom elevator and sluicing nozzle, namely 150 inches ($3\frac{3}{4}$ sluice-heads), which elevate 14 feet, and 150 inches which sluice down the tailings into the bottom of the pipe. They have another elevator of similar character. Two elevators are used where the vertical lift for one is too great. In the instance quoted the bottom elevator lifts the material and water 14 feet into sluice-boxes, and at the end of the sluice-boxes there is a well in which the other elevator is placed. If you can get water at a high elevation these elevators are splendid things, but they require a large body of water. A large number are now used here, and considerable improvements have been made on the first introduced. The head required to elevate gravel is in proportion to the height required to be lifted, which is from 10 feet to 13 feet for every 100 feet of head. Of course the quantity of water used also enters into the question greatly. If you can only get from 100 to 200 feet of head you could not calculate on lifting the ground more than 26 feet with the greatest head. The atmospheric elevators mentioned in my Report did not prove so effective as was anticipated,—indeed they are of no service except the intake orifice for the tailings or gravel is submerged, and this does not often take place. If the elevators were used in the bed of a river where the orifice was always submerged the atmospheric nozzle would be a great improvement. . . . . The diameters of the elevating nozzles vary from about $2\frac{1}{4}$ inches to 3 inches, but very seldom is the latter size used : $2\frac{1}{4}$″ and $2\frac{1}{2}$″ are about the diameters used in all the hydraulic elevators here."

The atmospheric elevators referred to are described in Mr. Gordon's Report for 1889 at pages 62 and 73, In describing the Fair Maid and Gladstone claims at Addison's Flat, in the Charleston District, he says :—"A water-race is constructed from the dam to the edge of the terrace, and from this point the water is brought down to the claim in wrought iron pipes, $18\frac{1}{2}$ inches in diameter, made of Nos. 12 and 10 B.W.G. iron. At the bottom of the terrace there are two branch pipes, 11 inches and 15 inches in diameter respectively, one for supplying water to the elevating nozzle, and one for supplying water for the breaking-down nozzle, both nozzles being $3\frac{1}{2}$ inches in diameter. There is 240 feet head of water at the claim, and it is proposed to lift the material with this head to a height of 36 feet 6 inches, which is too high for the head to work satisfactorily, unless a current of air is admitted into the bottom of the elevating pipe. It has been clearly demonstrated that the lifting capacity of the water is greatly reduced when the water and tailings are allowed to cover the opening at the bottom, showing that a current of air mixed with the water increases the force, and it is almost impossible to prevent the opening at the elevating pipe being choked at times. A patent has been obtained in the Colony by Mr. Robertson for an air-pipe connected with the bottom of the elevating pipe to remedy this defect. . . . . I have since learned that working has been commenced, and that there are about 80 cubic yards of material lifted by the elevating pipe per hour, about one-half of which is stones and pebbles, which go into the hopper. Everything works extremely satisfactorily."

The other reference to atmospheric elevators is in describing Mr. John Ewing's claim at St. Bathan's, Otago :—"Mr. Ewing has made arrangements to have two patent atmospheric elevators fixed, which are guaranteed to lift the material 30 per cent higher than the ordinary elevator, such as is used at Gabriel's Gully. The difference in this elevator is that there is a double nozzle, having a small space between them. The outer nozzle does not stand so high as the inner one, through which the water passes, and it is connected with a gas-pipe, which, when screwed into the casting forming the nozzle, stands above the water in the well in a vertical position. The velocity of the water passing through the nozzle causes the air to rush in through

the pipe, which has a cock on the upper end to regulate the supply. The elevating pipe, instead of being fixed down on the casting forming the nozzle, is held a certain distance above by four collar-bolts, having long screws on one end and double nuts to regulate the height. The ordinary elevator has a hole in the side of the pipe, having the bottom end placed down over the nozzle of the elevating jet instead of the pipe being suspended above it. This atmospheric elevator has yet to be tried, and Mr. Ewing is the first to try it. It will cost him £100 for each elevator. The guarantee that he has is that each elevator will lift one and a half times as much water as is used for elevating, together with as much material as can be sluiced down into the well from a height of 25 feet, with a head on the main supply pipe of 280 feet. . . . . At St. Bathan's Mr. Ewing has arranged to have another atmospheric elevator, making in all three of them; but this one is to lift an equal amount of water to that used in elevating, together with as much material as can be sluiced into the well from a height of 57 feet, the main supply pipe having a head of 440 feet. It will be interesting to know how these patent elevators act, and if they possess the advantages claimed for them."

An interesting example of comparatively high lift with a low head is given in the same report in describing Mace and Bassett's claim, Addison's Flat:—"Their elevating pipe is 10 inches in diameter, with a 3-inch nozzle, and they lift the stuff 15 feet with a head of 75 feet, which is far too small a head to lift the stuff this height satisfactorily; yet they are doing extremely well."

From the above descriptions it will be seen that there are great variations in the practice of hydraulic elevating. The use of two lifts in place of one where the distance required to be lifted is great appears to be a considerable improvement, and, after workings are well opened out, will often permit of a large proportion of the tailings being run back on to the worked-out ground without being lifted right out of the excavation. The first cost of the elevators is small, about £25, and the expense of maintenance is trifling. The liner, or bottom casting where no liner is used, in the bottom of the elevating-pipe, has to suffer a great deal of wear and tear through being battered by the heavy stones thrown against it by the force of the water. The Hercules Company, in Otago, now use solid castings seven inches in thickness, liners having been found not to stand, but to become splintered and broken. Mr. Gordon recommends the use of steel castings for liners and bottoms where heavy gravel has to be raised by a powerful jet. In some parts of the west coast of New Zealand I have seen the upper parts of the upraise pipes made of wood,—simply wooden boxes, in fact. These, however, are not so good as iron pipes, as they cause greater loss of power through friction.

In the following table I have collected all the principal facts that I have been able to obtain as to the working of elevators. The table is by no means complete, full particulars not being always obtainable.

Name of Mine.	Locality.	Size of Elevator Nozzle.	Size of Elevator Pipe.	Head.	Lift.	Material raised per hour.	Water used for breaking ground.	Water used for the Elevator.
		Inches.	Inches.	Feet.	Feet.	Tons.	Tasmanian Sluice-heads.	
Mace and Bassett's	Addison's Flat, N.Z.	3	10	75	15	...	...	...
Fair Maid and Gladstone	" "	3½	11	240	36½	120	...	...
Hercules Company	Clutha Valley, N.Z.	3⅛	?	450	44	38½	11·2	17·7
" "	" "	3⅛	?	450	50	38½	11·2	17·7
Island Block Company	" "	2½	15	760	64	40	9·0	14·3
Gabriel's Gully, Consolidated, 1890	Tuapeka, N.Z.	2½	15	375	25	59·4	7·6	20·4
	" "	2½	15	450	62⅔	59·4	...	17·9
" "	" "	2½	15	450	14	84	7·6	7·6
" " 1891...	" "	2½	15	450	68 5/12	84	...	25·5
" " "	" "	2½	15	420	12	...	40·8	
" " 1889...	" "	2½	15	420	35	...		
" " "	" "	2½	15	420	30	...	?	25·5
" " "	" "	2½	15	420	50	...	?	35·7
" " "	" "	2½	15	400	47	...	10·2	15·3
" " 1886...	" "	2½	15	350	37	...	...	15·3
Average (Dunn)	California	?	11 to 20	200 to 500	89 (max.)	...	...	...
Mammoth Bar	"	?	?	450	40	...	25	
Golden Gate River	"	2½	11	275	28	...	11	
" "	"	3	11	275	28	...	13	
North Bloomfield	"	?	?	530	87	150	50	81·3

A. MONTGOMERY, *Geological Surveyor.*

DIAMOND DRILLS.

Statement of Work done.

Year.	*Locality.*	*Direction of Bore.*	*No. of Bores.*	*Total Distance bored.*	*Average Cost per foot, exclusive 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 (Phœnix G. M. Co.)—For Gold[a]	Ditto	1	781	2 0 2
1890...	Beaconsfield (East Tasmania G.M. Co.)—For Gold[b]	Ditto	1	978	0 14 9½
1891...	Spring Bay—For Coal[c]	Vertical	4	748	Not yet to hand.
	Total	...	28	10,891	
	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, 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—Mt. Bischoff Alluvial T.M. Co.—For Tin	Ditto	7	1548	0 6 1½
	Waratah—Mt. Bischoff T.M. Co.—For Tin	Ditto	7	841	0 11 8
1887...	Ditto—Ditto	Horizontal, underground	1	53	0 7 8
1888...	Old Beach—For Coal	Vertical	1	593	abt. 0 10 9
	Campania—For Coal	Ditto	1	600	0 7 7½
	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	831	Not yet to hand.
	Total	...	33	8947	

Aggregate number of bores 61
Total distance bored ..... feet 19,838

[a] For details of this Bore see Appendix to Geological Surveyor's Report on Beaconsfield Goldfield, 10th July, 1891, *ante*.
[b] Ditto, ditto.
[c] Ditto, Spring Bay Coal, 29th September, 1890, *ante*.

W. H. GLOVER, *Commissioner of Gold Fields.*

Launceston, 30th June, 1891.

DIAMOND DRILL, No. 2.

Report of Strata passed through in boring for Coal at Macquarie Plains.

No. 1 Bore.

Strata.	Thickness.	Total Depth.
	ft. in.	ft. in.
Surface shaft	17 6	17 6
Dark sandstone, sharp and quartzose	2 5	19 11
Dark blue shale, mixed with quartzose sandstone	6 9	26 8
Grey sandstone	3 0	29 8
Black clod	0 6	30 2
Grey sandstone	0 9	30 11
Black clod	3 0	33 11
Grey sandstone	0 6	34 5
Black clod	1 0	35 5
Grey sandstones	3 2	38 7
Black clod	1 0	39 7
Grey sandstone	1 11	41 6
Black clod	0 6	42 0
Dark sandstone with coal markings	3 6	45 6
Grey felspathic sandstone (greywacké)	8 6	54 0
Dark grey fine-grained felspathic sandstone with coal stains	5 0	59 0
Black clod (felspathic mudstone) with coal streaks	0 4	59 4
Grey clod with coal markings	9 4	68 8
Purplish and grey coarse and fine-grained felspathic sandstones, with *phyllotheca*	11 0	79 8
Reddish grey felspathic mudstone and sandstone	11 9	91 5
Grey felspathic sandstone, with included mud pebbles, with a little coal	7 6	98 11
Dark clod	1 10	100 9
Grey clod with blue veins	4 0	104 9
Hard brown clod	6 8	111 5
Dark clod with fossil plants	0 6	111 11
Grey sandstone	4 10	116 9
Grey clod with plant impressions	0 9	117 6
Grey sandstone with plant impressions	6 1	123 7
Grey sandstone and clod with plant markings	9 0	132 7
Grey clod with plant markings	6 6	139 1
Grey sandstone	3 0	142 1
Grey clod and sandstone with plant markings	16 6	158 7
Grey sandstone	1 0	159 7
Grey clod	2 0	161 7
Dark clod with plant markings	0 6	162 1
Grey clod	5 6	167 7
Coarse grey sandstone (felspathic) with rounded mud enclosures; prints of *phyllotheca*	14 9	182 4
Grey clod	6 3	188 7
Grey sandstone	2 1	190 8
Grey clod	4 9	195 5
Grey sandstone	2 2	197 7
Fine-grained felspathic sandstone and mudstone with plant markings	9 8	207 3
Grey felspathic sandstone with rounded mud enclosures	6 8	213 11
Dark clod	1 0	214 11
Grey clod	3 4	218 3
Dark clod with fossils	1 6	219 9
Grey clod	1 4	221 1
Grey sandstone (felspathic) with coal markings	7 2	228 3
Grey clod	1 6	229 9
Grey sandstone with calcite veins	7 3	237 0
Reddish clod	0 6	237 6
Bluish clod	1 0	238 6
Coarse-grained grey felspathic sandstones with calcite veins	12 6	251 0
Dark clod with plant markings	0 2	251 2
Grey clod	0 7	251 9
Fine and coarser-grained felspathic sandstones and mudstones (clod) with carbonaceous markings	18 0	269 9
Grey fine-grained felspathic sandstones with carbonaceous markings	18 0	287 9
Grey sandstones with carbonaceous prints and a little calcite	10 0	297 9
Dark bluish mudstone (clod) with intermixture of a little felspathic sand, with carbonaceous prints and a little iron pyrites	6 0	303 9
Grey sandstone and calcite	1 0	304 9
Grey clod	0 6	305 3
Dark clod	1 2	306 5

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Grey sandstone with some calcite and coal markings, often containing rounded lumps of mudstone. (The sandstone consists of sub-angular fragments of felspar more or less converted into clay, but often pretty hard, together with a subordinate proportion of clear, sharp, angular quartz grains, and a little mica, held together by an argillaceous cement)	36	5	342	10
Dark felspathic mudstone, with *Phyllotheca* prints and one thin streak of coal	1	6	344	4
Grey fine-grained felspathic sandstones and mudstones with a little iron pyrites	11	3	355	7
Coarse greenish grey felspathic sandstone	20	3	375	10
Same, mixed with mudstone enclosures	12	3	388	1
Grey somewhat quartzose felspathic sandstone with coalstains and mudstone enclosures	11	10	399	11
Coarse-grained quartzose greywacke, or argillaceous sandstone, with mud pebbles and veins of crystalline calcite	11	6	411	5
Grey sandstone with mudstone layers	2	10	414	3
Grey clod (mudstone) with calcite	5	6	419	9
Fine-grained darkish grey felspathic sandstone, with carbonaceous markings	1	0	420	9
Grey felspathic sandstone	4	5	425	2
Fine grained felspathic mudstone	7	9	432	11
Dark felspathic fine-grained sandstone with coal markings	2	0	434	11
Grey mudstone	2	0	436	11
Dark very fine-grained felspathic sandstone, with coal markings and calcite	7	1	444	0
Grey sandstone	1	0	445	0
Dark felspathic sandstone, fine-grained, and with coal markings	14	9	459	9
Fine-grained quartzose felspathic sandstone, grey in colour	12	7	472	4
Coarse grey quartzose sandstone with very little felspathic matter	4	1	476	5
Sharp gritty quartzose sandstone, free from felspathic grains, freestone	4	0	480	5
Fine-grained grey quartzose freestone	10	4	490	9
Fine-grained dark grey shaly sandstone	10	10	501	7
Grey shale	0	8	502	3
Fine-grained shaly sandstones and speckled shales	35	1	537	4
Fine-grained quartzose sandstones and silicious speckled shale	35	11	573	3
Hard mottled sandstone	8	9	582	0
Light grey clay-rock or shale	8	0	590	0
Light grey arenaceous claystone with calcite	28	8	618	8
Hard bluish arenaceous claystone	4	0	622	8
Clayey sandstone with some calcite, passing into sharp quartzose somewhat micaceous sandstone	7	10	630	6
Dense fine-grained diabase greenstone	12	6	643	0
TOTAL	643	0	643	0

Bore commenced 19th February, 1891 ; finished 19th May, 1891.

No. 2 BORE.

Strata.	Thickness.		Total Depth.	
	ft.	in.	ft.	in.
Surface shaft	6	0	6	0
Brown sandstone	4	0	10	0
Grey sandstone	10	4	20	4
Grey clod	9	4	29	8
Greenish grey sharp quartzose sandstone, fine-grained and slightly micaceous	25	7	55	3
Grey clod	0	6	55	9
Grey sandstone with coal markings	3	6	59	3
Grey clod	2	0	61	3
Red clod	3	8	64	11
Grey clod	3	6	68	5
Red clod	21	10	90	3
Grey clod	5	6	95	9
Dark arenaceous shale with impressions of *Phyllotheca*, &c. Thin streaks of coal	3	0	98	9
Black clod	0	9	99	6
Grey sandstone	2	0	101	6
Red and grey clod	5	5	106	11
Grey clod	19	8	126	7
Felspathic arenaceous mudstone with coal markings	9	4	135	11
Dark micaceous shale and sandstone with coal markings	2	7	138	6
Light grey micaceous shale	4	10	143	4

Strata.	Thickness.	Total Depth.
	ft. in.	in.
Reddish and brownish felspathic sandstone and mudstone with plant remains	16 6	159 10
Grey sandstone	2 0	161 10
Dark sandstone with coal markings	2 0	163 10
Red clod	7 3	171 1
Grey clod	1 7	172 8
Dark sandstone with coal markings	3 0	175 8
Red clod	11 6	187 2
Grey sandstone	0 11	188 1
Red clod	2 0	190 1
Grey clod	2 0	192 1
Grey sandstone	7 5	199 6
Red and grey clod	10 7	210 1
Grey clod	12 0	222 1
Grey sandstone	3 0	225 1
Grey clod	5 5	230 6
Grey sandstone	2 0	232 6
Grey clod	2 11	235 5
Grey sandstone with iron pyrites	15 9	251 2
Grey sandstone	41 0	292 2
Grey clod	1 0	293 2
Grey sandstone	13 7	306 9

Bore commenced 15th June, 1891 : still in progress. Section given up to 11th July, 1891.

No. 1.

COMPARATIVE Statement of Gold won during the Years 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, *and the first Half-year of* 1891.

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
For the first half-year of 1891	13,110 0	51,164

No. 2.

RETURN showing the Quantity of Gold obtained from Quartz during the Years 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, *and the first Half-year of* 1891.

YEAR.	QUANTITY.	VALUE.
		£
1880	34,345 ounces	130,622
1881	45,776 „	174,956
1882	36,215 „	137,183
1883	36,672 „	138,060
1884	30,540 „	114,630
1885	33,266 „	124,234
1886	25,004 „	87,516
1887	33,427 „	123,453
1888	34,156 „	126,139
1889	33,069 „	116,517
1890	17,829 „	64,184
For first half-year of 1891	11,500 „	41,400

No. 3.

COMPARATIVE Statement of Tin exported from Tasmania during the Years 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, *and for the first Half-year of* 1891, *compiled from Customs Returns only.*

YEAR.	TONS.	VALUE.
		£
1880	3954	341,736
1881	4124	375,775
1882	3670	361,046
1883	4122	376,446
1884	3707	301,423
1885	4242	357,587
1886	3776	363,364
1887	3607½	409,853
1888	3775¼	426,321
1889	3764	344,941
1890	3209¼	296,368
For first half-year of 1891	1561	139,364

No. 4.

QUANTITY and Value of Coal raised during the Years 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, *and first Half-year of* 1891.

YEAR.	QUANTITY.	VALUE.
	TONS.	£
1880	12,219	10,998
1881	11,163	10,047
1882	8803	7923
1883	8872	7985
1884	7194	6475
1885	6654	5989
1886	10,391	9352
1887	27,633	24,870
1888	41,577	37,420
1889	36,700	33,030
1890	50,519	45,467
For first half-year of 1891	21,870	19,680

No. 5.

RETURN showing the Number of Persons engaged in Mining during the Years 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, *and and first Half-year of* 1891.

YEAR.	NUMBER.
1880	1653
1881	3156
1882	4098
1883	3818
1884	2972
1885	2783
1886	2681
1887	3361
1888	2989
1889	3141
1890	2868
For first half-year of 1891	3133

No. 6.

RETURN showing the Number and Area of Leases held under "The Mineral Lands Act" and "The Gold Fields Regulation Act," in force on 30th June of each Year since 1886.

Nature of Lease.	In force on 30th June, 1886.		In force on 30th June, 1887.		In force on 30th June, 1888.		In force on 30th June, 1889.		In force on 30th June, 1890.		In force on 30th June, 1891.	
	NO.	AREA.	NO.	AREA.	NO.	AREA.	NO.	AREA.	NO.	AREA.	NO.	AREA.
		Acres.		Acres.		Acres.		Acres.		Acres.		Acres.
Under "The Mineral Lands Act," for tin, &c., at a rental of 5*s.* an acre	627	24,077	656	22,892	957	32,231	1497	53,251	1303	49,463	1495	67,216
For coal and slate, at 2*s.* 6*d.* an acre rent	38	5487	62	10,665	41	6045	38	4499	51	7636	45	7255
Under "The Gold Fields Regulation Act," at a rental of 20*s.* an acre	110	1077	149	1474	285	2812	270	2687	325	3088a. 2r. 20p.	245	2366a. 2r. 10p.
Water Rights and Mining Easements	93	759 sluice-heads.	107	773 sluice-heads.	140	852 sluice-heads.	204	1005 sluice-heads.	209	950 sluice-heads.	200	998 sluice-heads.

No. 7.

RETURN of the Number and Area of Leases under "The Mineral Lands Act" and "The Gold Fields Regulation Act," in force on the 1st July, 1890, *issued during the Year ending* 30*th June,* 1891, *cancelled during the Year ending* 30*th June,* 1891, *and remaining in force on* 30*th June,* 1891.

Nature of Lease.	In force on 1st July, 1890.		Issued during Year ending 30th June, 1891.		Cancelled during Year ending 30th June, 1891.		In force on 30th June, 1891.	
	NO.	AREA.	NO.	AREA.	NO.	AREA.	NO.	AREA.
		A. R. P.		A. R. P.		A. R. P.		A. R. P.
Under "The Mineral Lands Act," for tin, &c., at a rental of 5*s.* an acre	1303	49,463 0 0	442	24,466 0 0	250	6713 0 0	1495	67,216 0 0
For coal and slate, at 2*s.* 6*d.* an acre rent	51	7636 0 0	2	133 0 0	8	514 0 0	45	7255 0 0
Under "The Gold Fields Regulation Act," at a rental of 20*s.* an acre	325	3088 2 20	49	480 0 0	129	1232 0 10	245	2336 2 10
Water Rights and Mining Easements	209	950 sluice-heads	20	135 sluice-heads	29	87 sluice-heads	200	998 sluice-heads

No. 8.

COMPARATIVE Statement of Net Revenue from Mines, being Rents, Fees, &c. paid to the Treasury.

YEAR.	AMOUNT.
	£ s. d.
1880	8944 5 11
1881	20,936 5 5
1882	23,077 1 9
1883	15,439 14 5
1884	6981 11 10
1885	11,070 5 7
1886	12,523 10 4
1887	14,611 11 5
1888	23,502 8 4
1889	17,254 9 0
1890	26,955 4 9

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

No. 9.

RETURN of Dividend Tax paid by Gold Mining Companies.

YEAR.	NO. OF COMPANIES.	AMOUNT OF DIVIDEND.	AMOUNT OF TAX.
		£ s. d.	£ s. d.
1880	5	65,852 17 2	2467 16 0
1881	4	99,250 0 0	3721 17 6
1882	5	55,825 0 0	2093 8 9
1883	5	63,168 10 0	2368 16 4
1884	4	39,400 0 0	1477 10 0
1885	2	61,250 0 0	2296 17 6
1886	3	41,125 0 0	1542 3 9
1887	2	66,750 0 0	2503 2 6
1888	2	65,375 0 0	2451 11 3
1889	4	28,000 0 0	1050 0 0
1890	3	13,609 0 0	510 6 9
1891, 1st half of	2	4200 0 0	157 10 0

No. 10.

RETURN of Dividend Tax paid by Tin Mining Companies.

YEAR.	NO. OF COMPANIES.	AMOUNT OF DIVIDEND.	AMOUNT OF TAX.
		£ s. d.	£ s. d.
1880	11	64,755 0 0	2428 6 3
1881	13	102,418 0 0	3840 13 6
1882	12	108,935 0 0	4085 1 3
1883	9	98,837 2 6	3706 7 9
1884	4	60,169 0 0	2256 6 9
1885	4	92,644 0 0	3474 3 0
1886	5	108,849 10 0	4081 17 1
1887	6	128,753 0 0	4828 4 8
1888	10	148,638 17 2	5573 19 10
1889	6	100,850 0 0	3781 17 6
1890	10	87,187 10 1	3269 11 1
For first half-year 1891	6	40,157 15 0	1505 18 4

No. 11.

RETURN of Dividend Tax paid by Silver-Lead Mining Companies.

YEAR.	NO. OF COMPANIES.	AMOUNT OF DIVIDEND.	AMOUNT OF TAX.
		£ s. d.	£ s. d.
1891, 1st half of	1	8640 0 0	324 0 0

WILLIAM THOMAS STRUTT,
GOVERNMENT PRINTER, TASMANIA.