



REPORT ON THUREAU'S DEEP LEAD, NEAR GEORGE'S BAY.

Mines Office, Launceston, 6th January, 1893.

SIR,

I have the honour to forward to you a description of the Deep Lead near George's Bay, first described by Mr. G. Thureau, F.G.S., late Government Mining Geologist, and hence known by his name. In August, 1888, reports were written by Mr. Thureau dealing pretty fully with the portions of the lead held by The Salisbury Prospecting Association, Messrs. Haley and Rattray, and the Kent Prospecting Association, and incidentally with it in general, but as these were made under the then prevailing system by which the Government Mining Geologist was allowed to furnish reports to private parties they were not officially published. Private reports have also been made to people interested by Messrs. A. R. Browne, M.F., and F. Danvers Power, F.G.S., but so far as I am aware no official report has ever been made for public information. As the lead has attracted a great deal of attention and is quite likely to prove an important source of tin ore, a description of it may now be useful.

Since Mr. Thureau made his reports above mentioned the properties therein described have been more or less completely absorbed by the St. Helen's Tin Mining Company, which now holds practically all the upper part of the lead for two miles above the point where it crosses the Golden Fleece Rivulet. Lower down the lead, near the junction of the Fern-tree Creek with the Golden Fleece, the workings known as the Ruby King Mine (sections held in names of J. W. Syme and F. J. Pike) are also on the deep alluvial ground, but, with the exception of two or three other claims, these and the St. Helen's Company's workings comprise the whole of the mining work yet done. There is still a great deal of vacant Crown land along the lead, and should the works now in progress prove it to be valuable, no doubt this will be taken up on mineral leases.

The country rock from George's Bay to the Blue Tier is all granite, with the exception of a piece of country to the south of the head of Medea's Cove, where slates and sandstones of probably Silurian age occur. These form the southern edge of the deep alluvial ground where it is crossed by Constable's Creek, and extend southward towards the Scamander River, being part of the extensive Silurian formation in which the Mathinna, Mangana, and Mount Victoria Goldfields are situated. Except for this occurrence of sedimentary strata the lead is entirely bounded by granite, and as this generally crops out on surface in numerous protruding masses, it is a simple matter to follow the boundaries of the alluvial ground. This shows on the surface numerous waterworn pebbles of quartz, occasional rounded boulders of hard granite, and sometimes boulders of basalt, often cemented together by brown oxide of iron. Much of the surface gravel is fine, but patches of pebble drift are not uncommon, and the thoroughly waterworn character of the stuff is unmistakable. On the solid granite country there is often much fine surface gravel derived from the atmospheric disintegration of the rock, but this is always more or less angular and not waterworn. By noting these differences and the outcrops of the solid bed-rock I was able to clearly trace the lead from the head of Medea's Cove to near the junction of the George's River and Power's Rivulet, a distance of $6\frac{3}{4}$ miles. The alluvial ground on which the town of St. Helen's stands appears to belong to it, and it probably runs right out under George's Bay. The course of the lead is shown on the map accompanying this report. Two branch, or rather tributary leads run into the main one, one running northward from the Ruby Dam and joining the main lead in section 286-87M, the other coming southward across the present George's River north of 1765-87M; the former is probably fairly deep, the latter has been proved by prospecting-holes to be shallow. The junctions with these branch leads are the only breaks in the continuity of the boundary line of the main deposit, and as both of them rise into the hills it is impossible that the outlet of the old river could have been through either, and they must be, as above said, tributary leads.

This deep lead is simply an old bed of the George's River, similar to the Brothers' Home lead at Derby and numerous other buried rivers elsewhere. In my reports on the Beaconsfield and Gladstone districts I have pointed out that in Early Tertiary times the northern part of Tasmania must have been higher above sea level than now, as river channels were cut out which are now far below tidemarks. The stream which cut out the Ophir Deep Lead at Beaconsfield, now 270 feet below the sea level, must once have run downwards into the sea; about the same time the Deep

Leads at Lefroy and Black Creek, now below sea level, were also running streams; and further eastward, in the Ringarooma Valley we find evidence to the same effect in the fact that the bottom of the old lead in the North Brothers' Home mine is at least 90 feet below that of the existing river. During this period the drainage from the Blue Tier Range doubtless ran down the Deep Lead now under consideration and carved a channel out of the granite rock. An important point to note is that the streams of the Early Tertiary Period seem all to have run considerably below those of the present day, the whole country having subsided since then, and consequently that it must be expected that the outlet of Thureau's Deep Lead is probably a hundred or more feet below the level of George's Bay.

The evidence of the gravel terraces round Mount Cameron and on the slopes of the Cabbage Tree Hill at Beaconsfield, and of the deposits of the Launceston Tertiary Basin, proves that between Early Tertiary and Middle Tertiary times a long continued subsidence of the whole of the northern part of Tasmania took place, during which the rivers gradually filled up the valleys they had previously eroded, and the sea encroached further and further inland. It was in this period that the stanniferous gravel of the old Ringarooma and George's River (Thureau's Deep Lead) valleys were deposited. The streams kept bringing down a little tin from the mountains along with the ordinary gravels, but owing to the fact that the river beds were in process of filling up, the sediments were not much agitated after being laid down, and consequently the ore could not become concentrated into heavy alluvial deposits. The case is different when a stream is cutting out its channel, for then the gravels are being from time to time scoured away and subjected repeatedly to a natural ground-slucing process, which results in their contained heavy ores finding their way on to the bedrock in the bottom of the gutter. The lowest parts of a lead contain the concentrated ore resulting from the washing of the stuff which has been excavated in the whole of the river basin, less the quantity that has been mechanically or in solution swept into the sea: hence their richness as compared with the later gravels filling the upper parts, which are derived from a less quantity of rock and have been less frequently sluiced by the river. Attention is drawn to these facts, because Thureau's lead has been thought little of on account of the small quantity of tin in the upper drifts. The top layers of alluvial matter in the Brothers' Home lead are similarly poor, and yet it has been proved that there are rich deposits in the lower part of the gutter, and in the same way we are likely to get rich ore in the bottom of the former lead. The general occurrence of tin ore through all the top layers proves that the rivers kept bringing down supplies of it continuously, and gives good ground for thinking that in earlier times when the conditions were favourable for the concentration of the material, rich gravels must have resulted.

The movement of subsidence came to an end about the time of the great eruption of Tertiary basalts which we find overlying the drifts at the Brothers' Home, Scottsdale, and Lefroy. The land then again began to rise slowly and the sea to recede. The streams then began to cut into the accumulated sediments of the preceding period of subsidence, washing them away more or less, and forming new channels which had not necessarily any relation to the older ones. As the elevation went on these new channels have been cut deeper and deeper, so that we now find the Ringarooma and George's River running in rock-bound granite channels roughly parallel to the old beds in which they ran in Early Tertiary times.

The surface of the old lead now is far from level, having been carved into rounded hills and occasional deep gullies by the action of the surface waters running over it. It is noticeable that the centre of the alluvial ground is generally higher than the edges, and that the watercourses often run just at the contact of the gravels with the granite bed-rock: this is no doubt due to the porosity of the alluvial drifts allowing the rain which falls upon them to soak down into their substance without running off and scouring the surface. At the edges, however, the water running from the solid granite country has scoured away the soft drift matter and established water-channels, which have worn deeper and deeper as time went on. The highest part of the lead is in sections 1123-87m and 1124-87m, where the surface is about 265 feet above the sea; in section 1283-87m it is about 250 feet. Where the Golden Fleece Rivulet crosses the lead the alluvial matter has been greatly worn away and the surface level is about 100 feet above high-water mark, but rises again considerably between this point and the Fern-tree Creek, which again cuts deeply into the accumulations of gravel. From here to the head of Medea's Cove the lead sediments have been greatly worn away and the ground slopes gently down to the beach, but an indication of the former height to which they rose is afforded by a spur or hill lying east of Constable's Creek between A. Becker's 50-acre and 103-acre purchased blocks of land, which rises to a height of 170 feet above the sea, and is composed of waterworn gravel cemented by brown oxide of iron. This cemented stuff being hard has resisted erosion, and remains to show that the whole valley was once filled with alluvial detritus to probably at least 200 feet above the present sea level.

I have not myself seen any marine shells in this district in positions which would confirm the above explanation of the formation of the deep lead through subsidence and re-elevation of the land, but I was informed by Mr. Potter, formerly Manager of the St. Helen's mine, that some had been found in the workings near the Ruby Dam, up the Golden Fleece Rivulet: this would indicate a former subsidence of the whole countryside to a depth from 250 to 300 feet below its present level,—quite in accordance with the view I have taken of the lead.

As far as I could see or learn, no trace of the lead is found to the west of the junction of Power's Rivulet with the George's River, and there is nothing to show down which of these streams

the main body of stanniferous drift came into it. Probably both existed in the days when the lead was being formed, with their main valleys much in the same position as now, and contributed tin ore to the drifts. In the Early Tertiary times, however, the Blue Tier Range must have been higher than it is now, as denuding agents have been at work wearing it down unceasingly ever since then, and the modern river valleys are probably now much below the level at which the streams ran that carved out the channel of the lead; consequently it is probable that all the ancient river bed above the junction of the Power and the George has been completely eroded away, and traces of it higher up the range are therefore unlikely to be found. It may be here noted that though the subsidence of the lower grounds below sea level would result in filling up the lower parts of the old river channels, and the subsequent re-elevation would cause the rivers to cut new beds, the higher parts of the valleys that did not become submerged would remain unaffected, and the water would flow through them in one ever-deepening channel all the time. So long as the flow of a river is so fast that it is constantly scouring out its bed it is plain that no large deposits of gravel can form in it.

St. Helen's Company.

The mineral sections lately held by this Company are numbered 1863-87M, 1607-87M, 1605-87M, 1473-87M, 1283-87M, 1282-87M, 1539-87M, 1123-87M, 251-87M, 1124-87M, 1482-87M, and 1543-91M, comprising in all 300 acres. In the south part of section 1863-87M a shaft was sunk close alongside the Golden Fleece Rivulet to a depth of 57 feet, but did not strike the granite bottom. The flow of water became too strong to be overcome without machinery, and the shaft had to be abandoned. Occasional boulders of basalt were found in this shaft which must have come a long distance, as this rock does not occur anywhere in the neighbourhood. To the east of this shaft there is an outcrop of granite, and the Golden Fleece Rivulet runs over the bedrock, but further east again on sections 1750-87M and 1437-87M we come on the old alluvial ground, here much cemented by ferruginous matter and showing occasional stones of basalt similar to those got in the shaft. It seems very likely that the main gutter lies in these sections, and that the shaft is to the west of it, which would lead to the belief that the bottom of the lead is probably much below the depth reached in sinking.

In section 1473-87M two shafts have been sunk to depths of 40 and 60 feet respectively, through light gravel, coarse sand, and clayey drifts, containing a little tin ore throughout. These could not be sunk deeper by manual labour on account of water, and did not reach the bedrock. They are situated in some of the highest ground in this part of the lead, and in order to get below them an adit was being driven at the time of my visit from a point about 30 feet above the Golden Fleece Rivulet. A good deal of trouble was experienced in driving this, owing to the soft nature of the ground passed through, and the amount of water in it. It will have to go about 1420 feet in order to be under the highest part of the lead in section 1473, and will then be 110 feet below the surface. This adit seems to me to be a very useless piece of work; it is 30 feet above the Golden Fleece Rivulet, and therefore about 85 feet above the bottom of the deep shaft there, which itself did not reach the bedrock. We may therefore say confidently that the adit starts some 85 feet at least above the gutter, and it will therefore have to be driven a very long way before it reaches the lower layers of drift. It will certainly drain the surface layers, but these are so far above the gutter that they are not likely to be worth working, and if not the adit is quite useless. It seems to me to have been begun in the belief that the lead is comparatively shallow, and that by driving up it the bottom would soon be met with, but in my opinion the evidence is against this view, and the lead is probably deeper than it has been imagined.

In section 1274 there is a shaft 55 feet deep, which reached the bedrock, but is probably a long way from the gutter. In the north-west angle of section 1539 there is another, 40 feet deep. In section 1123 a shaft 57 feet deep was sunk near the roadside but did not reach bedrock. There are also three old shafts in sections 1124, 1180, and 1273, about 18, 20, and 70 feet deep respectively, the two latter of which appear to have bottomed on the granite. In all these shafts the drift is very light gravel, carrying a little tin ore. The tests that have been made from them have been contradictory, but the truth appears to be that the ground passed through does not contain tin ore in payable quantities except perhaps when treated on a large scale by the hydraulic process of sluicing. In section 251 a large excavation from 12 to 20 feet deep and about 15 chains long has been sluiced out along the edge of the deep ground, the debris being washed into the George's River, but this work did not pay, the ground being too poor. In order to get fall it was necessary to work along the edge of the granite and against the dip of the gravel drifts, and this sluicing cannot be considered a fair trial of the lead, though indicating probably pretty nearly the value of the superficial gravels.

Near the Golden Fleece Rivulet the ground is commanded by what is known as the Clio Water-race, and a good deal of surface work has been done by tributers. It has consisted principally in stripping off the surface vegetation from a layer of cemented drift which often lies about a foot beneath the surface and follows the contour of the latter. The explanation of this superficial layer being payable no doubt is that it contains the ore concentrated from a considerable mass of drift which has gradually been worn away by the action of surface waters, the light sand and gravel having been removed, while the heavier tin ore remained. In some of the small gullies, too, nice patches of tin have been worked, similarly resulting from natural sluicing of the poorer drifts. A good deal of prospecting has been done over the alluvial ground, and many places are said to be known where tributers could make a living if they were able to get water for sluicing and outlet for the tailings, both of which necessities are rather hard to obtain.

When the hydraulic sluicing work was in progress in section 251 the tin ore obtained was far from clean, being contaminated with titanite iron, rutile, zircons, pleonaste, and other heavy valueless minerals. A mistake appears to have been made in not trying to "stream" the ore cleaner, as a great deal of the impurities could have been removed by doing so. The low assay value of the tin ore obtained has given a bad name to the lead, which is undeserved, as the later results show. The following figures are from the returns received from the Tasmanian Tin Smelting Company, Launceston, for parcels of ore sent by the tributers:—

	bags.	cwt.	qrs.	lbs.	assay	
26th August, 1892.	4	3	3	4	71.4	per cent. metallic tin.
"	9	7	3	8	63.2	"
"	9	8	2	25	62.1	"
9th September, 1892.	7	6	2	7	58.4	"
"	4	3	1	4	70.2	"
"	5	4	3	6	70.8	"
"	1 (seconds)	0	3	19	43.1	"
13th October, 1892.	4	3	3	13	71.5	"
"	3	2	1	11	72.2	"
"	3	2	3	7	70.6	"
"	1 (seconds)	0	3	17	44.7	"
"	2	1	3	25	71.6	"
"	1	0	2	16	71.0	"
"	1 (seconds)	0	3	16	51.6	"

These returns show that it is quite possible to clean the tin ore from this ground sufficiently to yield over 70 per cent. of metallic tin, which is a highly satisfactory percentage. The ore from the Ruby King workings lower down the lead is also of good quality, and I have no doubt that with proper care in streaming all the tin ore obtained from the whole length of the lead could be brought to a fairly high assay value.

Bartley's Workings.

Near the head of the lead, on old sections 2864-87M and 2865-87M, Mr. D. Bartley has been working some gravels in a small watercourse which runs down into the George's River. Though the ground was shallow where he began work, it appears to be getting deeper going towards the lead. The tin ore is pretty coarse and well waterworn, and is not unlikely to be derived from the main lead. The bottom of the latter is here probably shallow, and the lower gravels would therefore be liable to be cut through by the surface watercourses, and it seems very likely that these are the source of the tin now being found. A series of shallow prospecting shafts along the west boundary of section 2864 would be very likely to find the top of the deep lead gutter, and would get it in a place where it could be pretty easily worked by a deep tail-race or adit from the valley of the George's River. Any such approach to it, however, should be deep enough to get well below the part of the gutter to be worked, as the fall of this is, of course, down the lead and not into the modern valleys.

Ruby King Mine:—Sections 958-87M, 292-87M, 1125-87M, 1088M, and 1464M.

A large amount of superficial work has been done on this ground, but nowhere has the bedrock been reached. The drifts are mostly light gravels and sand, with clayey beds between them. In several places I noticed flinty cemented quartz gravel, forming a very hard conglomerate, similar to that found in parts of the old Mussel Roe Lead near Gladstone. In some places a layer of this conglomerate is said to have been taken to be the bedrock, but it is not so, being only a layer of gravel that has been strongly cemented together by siliceous infiltrations. Owing to denudation of the upper drifts of the lead the strata worked by the Ruby King miners are probably lower relatively in it than those in the St. Helen's Company's ground, which will probably account for their greater productiveness; but still they must be far above the bottom of the gutter. A great deal of tin ore has been taken from these sections, which have been worked for many years.

Future Working.

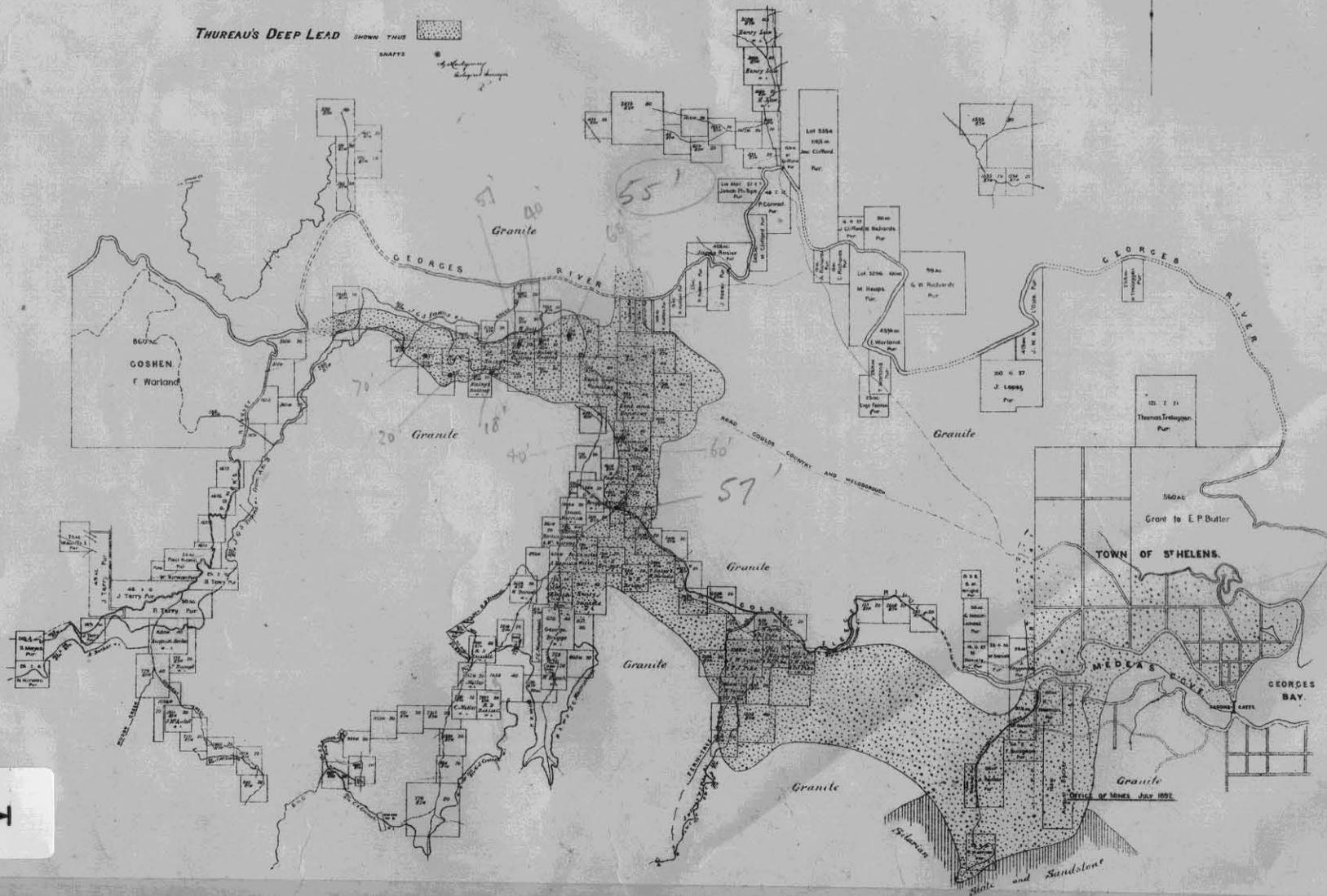
It will be seen from the foregoing that a little tin ore is found all along the course of the lead, and that practically nothing has yet been done to ascertain the depth of this and the quality of the gravels in the gutter, where the best "wash" is always reasonably, and according to universal experience, expected. The future of the lead depends on these lower gravels, and as there is good reason for expecting them to be payable, there is every inducement to make a vigorous effort to exploit them. The best method of doing so is now to be considered. Believing as I do, from consideration of the geological history of North-Eastern Tasmania, that the gutter will run deep below sea level at its outlet, I do not think that any good can result from adits driven from the George's River or from the side of the Golden Fleece Rivulet into the gravels, as they are pretty certain to strike them far too high. An adit driven up the lead from the Golden Fleece in section 1437 would in time strike the bottom of the gutter, but would probably have so far to go that it would be of very little use. The prospecting will therefore have to be done by means of shafts. Experience has now shown that these cannot be sunk by manual labour alone on account of the large amount

**MINERAL SECTIONS.
GEORGES BAY.
PARISH OF EASTWOOD.**

Scale 80 Chains to One Inch.

THUREAU'S DEEP LEAD  SHOWN THUS

SHAFTS



5 cm

Ruby King

5/10

of water in the ground, and engines will therefore be required. It will be an expensive matter, however, to prospect in this way without some guide as to the depth of the gutter and its position, and I should therefore recommend that boring with a diamond drill or water-auger be resorted to before any shafts are sunk. A few holes run down with these machines will test the value of the ground to a certain extent and will locate the gutter, and when this has been found it will be possible to pick out a site for a main shaft in a position favourable for working. The main shaft should be sunk in the granite to one side of the lead so as to be safe, and a drive from it to be put in under the gutter. The lead can then be drained properly by an engine on the shaft, and working carried on right up the deepest part of the lead in a miner-like fashion. The preliminary finding of the gutter by bores has come to be regarded as of the greatest importance in working deep alluvial ground, and the expense of the work is more than made up for by the certainty with which the permanent shafts and drives can be laid out.

As will be seen from the plan of the lead, its narrowest part is just north of where the Golden Fleece Rivulet crosses it, and this would therefore be the best place to put down a line of bores from east to west. It might be more convenient, however, to put the bores along the bank of the Rivulet, as water for the engine would there be at hand. At least three bores should be made, and it would be better to have six or more, so as to locate the deepest ground pretty exactly. The cores brought up by the drills would afford a good test of the value in tin of the drift passed through, but too much reliance should not be placed on these, and the main function of the drill should be to find the gutter. This being found, the proper and satisfactory exploration of the stanniferous gravels can only be done by mining methods.

Water Supply.

In every alluvial district the question of a supply of water is of the utmost importance. At present the St. Helen's Company have the Clio Race, which carries 7 heads of water, and could be made at small cost to carry 15, but this race is not high enough to command all the upper parts of the lead, being only about 100 feet above the Golden Fleece Rivulet. Another race, about 14½ miles long, has been surveyed from the George's River, to bring in 80 heads of water, at a cost of £8000, but this, too, is at a low level, and only 24 feet higher than the Clio Race. It is said that a race which would command all the lead, giving a pressure of 250 feet at the Golden Fleece crossing, could be got from the Scamander River, but that only about 20 heads of water could be safely reckoned on from this source for nine months in the year. It is thus a matter of considerable difficulty to get a copious high-level water supply, and it would probably be necessary to go from 20 or 30 miles up the George's River before a satisfactory one could be obtained. With the Blue Tier range close at hand, however, there should be no insuperable difficulty in the way of getting whatever water is required, and at a sufficiently high elevation, and the supply would resolve itself into a question of cost, which at present the absence of data does not permit discussion of. Should the upper gravels of the lead prove to be payable by hydraulic sluicing, the quantity to be washed is so immense that it would pay to construct an expensive race. Extended and very careful quantitative trials of the quality of the drift by sinking shafts all over it and washing the material therefrom are however required before it would be possible to judge correctly as to whether the upper layers are payable, and till these are made no steps should be taken towards making a big race. There is need for a very considerable expenditure in prospecting work over the whole of the lead before any expensive permanent works are begun, and the owners will have to exercise considerable patience in developing their properties.

My examination of Thureau's Deep Lead has led me to the conclusion that there is a very great probability of the existence of rich stanniferous gravels in the lower parts of it; that it is possible, but somewhat doubtful, that the superficial portions may be profitably worked by hydraulic sluicing; that the principal method of working will have to be that of underground mining, and that prospecting by boring is a necessary preliminary to the regular mining work. The deposit is very extensive, and if payable will afford employment to a large number of men, and it is highly desirable that its importance should be recognised and prospecting by boring begun upon it without delay.

I have the honour to be,

Sir,

Your obedient Servant,

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

The Secretary of Mines, Hobart.