

REPORT ON THE ROY'S HILL TIN MINE.

Geological Surveyor's Office, 5th October, 1893.

SIR,
ON the 26th and 27th of last month I visited the Roy's Hill Mine, and have now the honour to report upon it.

The mine is situated on freehold property near the south-west corner of a block of 2560 acres formerly held by Robert Hepburn, on the south side of the St. Paul's River, eight to nine miles by road from Avoca. Access to it is very easy, as a good road from Avoca to the East Coast runs through the block, and from this a practicable cart track, about half a mile long, leads to the workings; this track could, with little expense, be improved so as to become an excellent road, as the country over which it passes is nearly level and of gravelly nature. The mine lies just at the foot of the range of hills which form the south side of the St. Paul's River Valley, on a low flat spur running north-north-westerly into the river flats.

The lower spurs of the range are mainly composed of granite, similar to that of Ben Lomond, the Blue Tier, and Mount Cameron; this is well seen to the south-east from the mine. Lying upon the granite in horizontal strata we often find conglomerates, grits, sandstones, and fossiliferous mudstones belonging to the marine beds of our coal measures (Permo-Carboniferous). The spur on which the mine workings lie is capped with these younger strata, which, towards the south, cover and conceal the outcrop of the lode. West of the workings still another formation is represented, as we here come upon a patch of the old Silurian, or perhaps Archæan, metamorphic rocks, quartzites, sandstones, and slates; these probably are part of the same series of old rocks as are seen on the south side of St. Paul's Dome, at the neck of the Freycinet Peninsula, at Storey's Creek on Ben Lomond, and on the Mangana and Mathinna gold-fields; the granite is younger than these, and has been intruded through them. The lode which is now being worked lies along the contact of the granite and quartzite formations, and is probably due to alteration of the granite by hydrothermal action along the margin of its mass. To the northward from the mine the older rocks soon disappear beneath the more recent alluvial deposits of the St. Paul's River Valley, but are again found north of the river on the foot-hills at the base of St. Paul's Dome. The alluvial deposits are mostly of early Tertiary (Palæogene) age, and on the Benham Plains are overlaid with vesicular basalt; they belong to the same period as the older fluvial and lacustrine deposits of the Launceston Tertiary Basin, which are also in places overlaid by similar basaltic flows.

The old rocks carrying the lode are generally covered by these newer formations, or obscured by detritus derived from them, in the vicinity of the mine, and the discovery of the latter must be regarded as a lucky one, considering that a very small patch only of the bedrock was exposed.

The map sent herewith will be useful in showing the relative positions of the various mining workings to be described. It is not from accurate survey, but simply from a rough traverse with hand compass and tape, but will be sufficiently correct to show the general shape of the lode. The section is not to scale, but is a diagram to represent the relations to one another of the Tertiary, Silurian, Granitic, and Permo-Carboniferous formations.

As already remarked, the lode is a contact mass lying between the granite and quartzite formations. In all the holes and trenches, except that south of No. 4 shaft, the sedimentary rock is seen on the western margin of the granitic mass. The dip of the contact plane is generally rather flat to the westward, as if the body of granite were rapidly getting larger going downwards, but in No. 2 shaft it is to the eastward, and all through it is very variable. The main granite mass is not seen close to the workings, and I was in some little doubt as to its presence, but Mr. Pilbeam, the manager of the mine, was good enough to sink a hole on the eastern side of the spur to determine what the country rock there really was, and after passing through six feet of superficial matter the ordinary porphyritic granite was met with. The stone exposed on the eastern side of the line of contact is nowhere cut through to the main mass of regular granite, and is itself somewhat difficult to describe, varying a good deal both in composition and appearance. Generally it is mainly composed of granular quartz, with silvery white micaceous flakes rather sparingly distributed through it; but at times there is much mica, and sometimes there is a good deal of talc. In parts there is much kaolin, derived, no doubt, from decomposition of felspar. The softer parts of the lode containing mica, talc, and kaolin seem on the whole to be the richest in tin ore, but good tin is also found sometimes in even the hardest and densest of the stone. There is a great deal of black and brown tourmaline through the lodestuff, some of which is very difficult to distinguish from tin ore

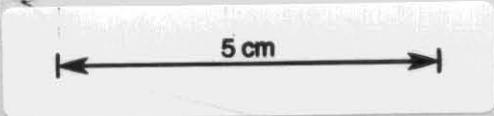
without crushing it: the tourmaline is distributed in patches, some parts of the lode containing large quantities of it, others but little. Irregular small veins of white quartz are often found in the softer parts of the lode, and some of the richest patches of tin ore have been found close to these. As far as yet seen I have been unable to detect any appearance of banded structure in the lode-matter, the arrangement of the materials in it being seemingly quite irregular, patches of soft stone, hard stone, micaceous stuff, stone full of tourmaline, and so on, coming in and going out quite suddenly. The tin ore seems to partake of the same irregularity of distribution, not being in recognisable veins, but in patches. On the whole, the lodestuff right on the contact with the metamorphic sandstones appears to be softest and most full of tin ore, a lot of it being exceedingly rich, but going eastward the lodestuff seems to become more like greisen (a granite composed of quartz and mica without felspar), gets hard, and does not generally appear to carry much tin ore. In many respects this lode corresponds pretty closely to the dyke or contact mass in the Fly-by-Night Claim at Gladstone, which has been better laid bare by sluicing than the Roy's Hill one. The stone is very similar, and both bodies are, in parts, rich in tin. The Fly-by-Night stone is found on the contact of the granites of Mount Cameron with the Silurian or older slates and sandstones of Gladstone township, just as the Roy's Hill lode is on the contact of a similar granite with a like sedimentary formation. It is probable that the latter lode will be like the former—a large wide mass of very variable composition and uneven distribution of tin ore, necessitating rather extensive and well-directed prospecting before there can be any assurance of profitable mining resulting.

The mining works that have been carried out are shown on the plan, consisting of several shafts and trenches. No. 1 shaft, the most southerly of all, is 50 feet deep, and from the bottom of it a drive has been made to the westward 30 feet. For 30 feet down the shaft followed the contact of the quartzite and granitic formations, dipping westerly about 78° , but the wall then dipped very flat away to the westward, and was not cut in the drive from the bottom of the shaft for 30 feet, when it was again met with, still dipping westerly about 11° . In the top part of the shaft there was a little tin in the softer stuff, but nothing very rich, and there was some tin found in the surface soil to the eastward of it, but in the lowest 20 feet the rock was very hard and poor or barren. The drive passed through the same hard micaceous stone for two or three yards, and then got into soft felspathic and greenish talcose stuff, which, however, only carried occasional specks of tin ore. At 30 feet there was a small good patch of ore in the shaft, really very rich, the tin ore being disseminated in fine grains right through solid dense micaceous quartz, but this was soon cut through. On the whole, therefore, the lode in this shaft is very poor.

No. 2 shaft is 119 feet N.N.W. from No. 1, and is about 25 feet deep: it is sunk along the quartzite wall. For the first 12 feet the wall dipped slightly westward, then turned over to the east, and the average underlay of the shaft has thus become 1 in 10 to the eastward. The lower part of the wall is well defined and like a regular lode-wall, and strikes N. 15° W. For about 12 feet down there was very rich ore in this shaft, the tin lying mostly in a vein dipping at a flat angle to the westward, but lower down hard micaceous granular rock was met with, and very little tin was found. Here the quartzite wall and lode were both much seamed with thin red veins of oxide of iron, probably oxidised pyrites, lying generally very flat; in some of these the manager told me he had got tin. A drive has been extended eastward eight feet from the bottom of this shaft in the same hard rock as in the bottom of No. 1 shaft, but no tin of consequence was found in it. On surface a trench has been carried along the lode from this shaft for about a chain in length, and from 8 to 10 feet deep. Some very rich ore has been got from this, and is still visible in the bottom. About $3\frac{1}{2}$ tons of this were lying bagged for sending away at the time of my visit, and several tons had already gone to Sydney for treatment. About $2\frac{1}{2}$ or 3 tons of the same rich ore (probably containing about 20 per cent. of black tin) were at surface ready to put in bags, and there was also a heap of about 40 tons of second-class stuff raised, which should be highly payable if crushed on the mine.

No. 3 shaft is 119 feet N. 15° W. from No. 2, and is about 32 feet deep. It underlays a little to the westward, following the quartzite wall. On its north side a small stope has been taken out from a depth of 22 feet to surface, and about 15 feet in length. Excellent ore was got in this and in the top part of the shaft. In the bottom the hard quartzose micaceous rock again is found, and is not rich, though occasional good patches of rich ore are distributed through it. A good deal of ore has been raised from this place, and there were on the ground about 17 tons that had been bagged for removal, 10 tons being stuff that the Manager estimates would yield 10 per cent. of black tin and 7 tons that should give 30 per cent. Nearly 15 tons have already been sent away, and have yielded 30 per cent. of black tin. On the ground there is still a little of the best ore not bagged, and about 30 tons of the estimated 10 per cent. stuff, with probably 20 tons more of poorer dirt that would pay well for local treatment. Not having actually had the heaps measured and sampled myself, the above figures are those of the Mining Manager, but from inspection I should judge them to be fairly correct.

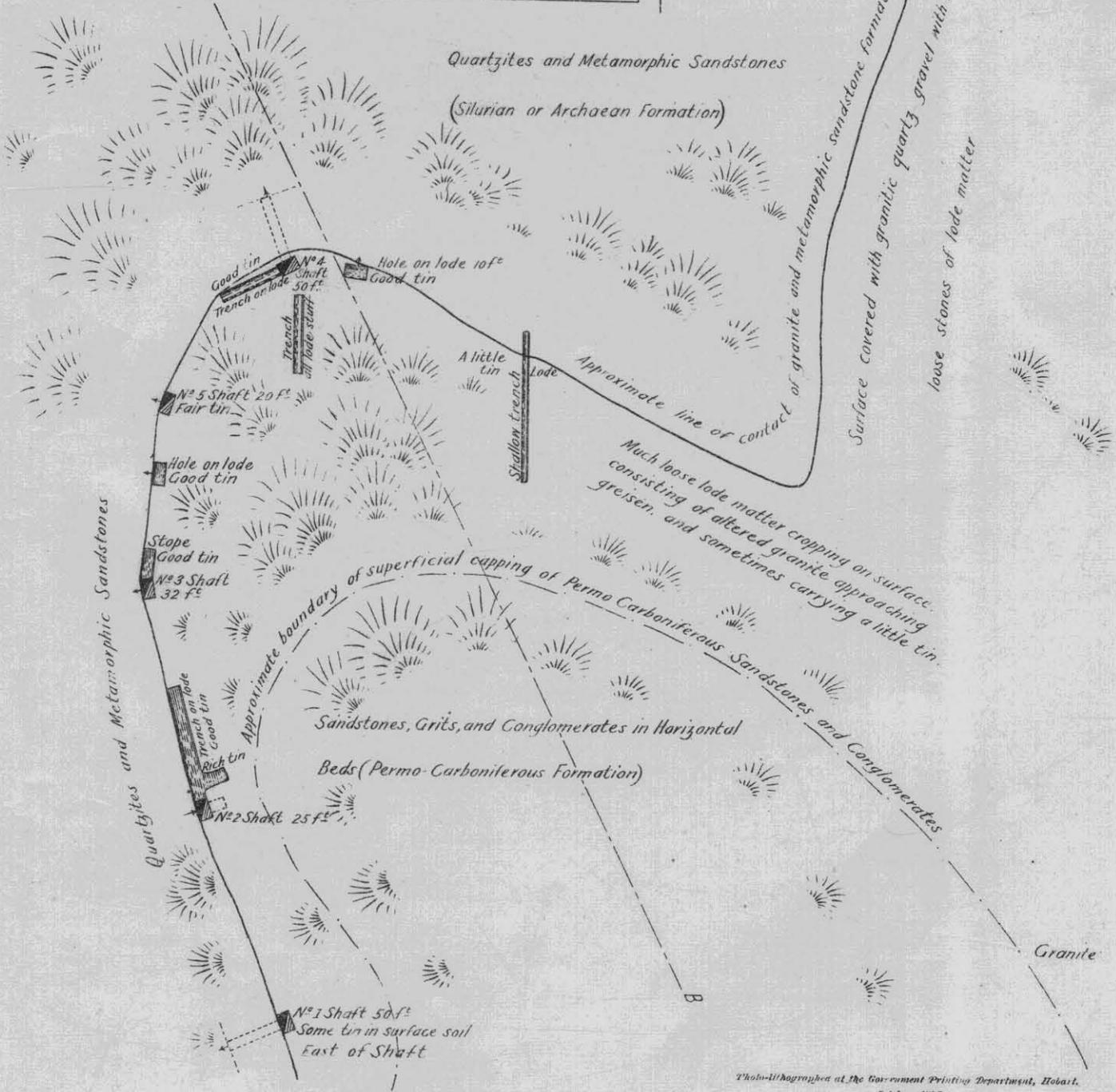
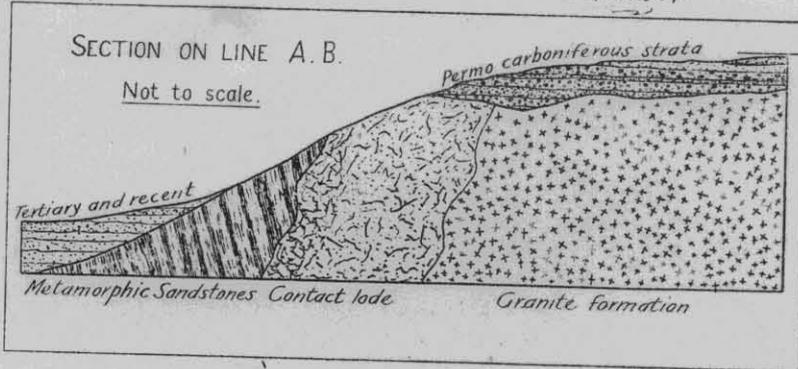
Sixty feet north of No. 3 shaft a hole about 6 feet deep and 5 feet wide has been sunk on the lode, exposing the quartzite wall dipping westerly (underlay about 1 in 5), and showing very good ore. The tin is here in very hard and solid stone as well as in the softer stuff, and looks better for permanence than in the other workings. About 3 tons of good ore have been raised from this place.



Plan of the ROY'S HILL MINE

Scale of 80 feet to 1 inch.

By Montgomery
Geological Survey
5th October 1893



No. 5 shaft is 97 feet N. 5° E. from No. 3, and likewise underlays to the westward. It was 20 feet deep the day I saw it, and was being sunk deeper. There has been fair tin from top to bottom of it in a soft layer lying on the quartzite wall, and varying from 5 feet to 18 inches in thickness. The hard rock on the eastern side of the shaft seems to be generally poor. About 9 tons of fair ore, that would probably yield 4 or 5 per cent. of black tin, have been raised from this shaft.

About 63 feet N. 27° E. from this the lode begins to turn rapidly round to the eastward, still following the contact of the granitic and metamorphic sandstone formations. A trench 5 or 6 feet deep has been dug along the outcrop for 38 feet N. 63° E. to No. 4 shaft, and from this a good deal of fair ore has been raised, mostly from soft rock. No. 4 shaft is vertical, and 50 feet deep, and from the bottom of it a drive has gone 34 feet to N. 20° W. In the face of this drive the Silurian rock is met with, the wall dipping flat to N. 35° W., at an angle of 15° to 17°. The bottom of the shaft and first part of the drive are in soft quartz porphyry, with the felspathic matter much decomposed, but towards the face the rock, though still pretty soft, is more micaceous. With the exception of one or two places, the rock passed through in both shaft and drive has been quite poor in tin. To the south of the shaft a trench about 40 feet long has been cut down into the bed-rock, showing some good tin ore in hard stone towards the northern end. The stuff towards the south end is poor or barren. This trench is useful as showing the width of the lode, and also that good tin exists in portions of the hard rock quite a distance away from the softer stuff on the quartzite wall that generally appears to carry the most tin.

East of No. 4 shaft 35 feet another hole about 10 feet deep has been sunk in the lode alongside the sandstone wall, showing payable ore in soft rubbly micaceous lodestuff. About 80 feet further east a long shallow trench has been cut north and south, but not deep enough to expose the bed-rock thoroughly. At its north end we find loose angular pieces of quartzite and metamorphic sandstone for about 12 feet, then micaceous granular quartzose lodestuff for the rest of the distance to the south. At the contact of the two sorts of rock a little tin has been obtained. This is the last trench but one upon the lode, but to the eastward from it there is much outcropping micaceous granular quartzose rock, similar to that found to the east of No. 1 and No. 2 shafts, and in the south end of the north and south trench at No. 4. This often carries tourmaline, and sometimes a little tin ore is seen. The contact of the granitic and sedimentary formations can be traced as shown on the plan by the difference in the surface stones, hard angular sandstones being common to the west of the line drawn, and fine angular quartz gravel, micaceous quartz, quartz, and tourmaline, and other granitic detritus to the east of it. A trench shown in the north-east corner of the plan again shows lode-matter full of tourmaline lying alongside the solid Silurian rock, and makes it likely that the lode will be found to follow the contact line right round all its sinuosities. This peculiarity of contact lodes, as distinguished from ordinary fissure veins, will require to be borne in mind in working and further prospecting this mine. It is likely to be variable and irregular both in strike and dip, its shape depending on that of the original granitic intrusion.

From the above detailed account of the workings it may be gathered that rich tin ore, mostly in soft talcose, clayey, and micaceous rock, has been found in the lode for a distance of about 350 feet, but that all the deeper shafts have been as yet unsuccessful in getting ore of good quality at quite a short distance below the surface. Must we therefore jump to the conclusion that the occurrence is simply a "surface patch," and that the tin will cut out when sunk upon? I think not, for this would imply as a consequence that proximity to the surface in some way affects the deposition of tin ore in lodes, which is a proposition opposed to the most generally accepted views on the subject. According to these it is most probable that tin lodes were originally formed at great depths below the surface of the ground, and that they have in course of time been revealed by the removal of immense masses of superincumbent strata by long continued denudation. If so, the original distribution of the ore in the lodes could in no way have anything to do with the present surface line. In the cases of some lodes, especially those of copper and lead, we know, however, that there is often a superficial enrichment of the higher-lying parts of the lodes through the action of the atmosphere and rain in decomposing and dissolving the metals in the outcrops, and causing the formation of solutions which find their way down into the lode mass, and enrich the ore there by being again deposited. But we have no evidence of any such chemical enrichment in the case of tin lodes, and the talc, mica, and tourmaline found in the present instance with the tin ore are not minerals commonly found as products of superficial alteration, but rather such as appear to be formed under conditions of considerable heat and pressure; so it is very improbable that the deposition of the ore has been in any way dependent upon the accident of its position near the present surface. It is of interest to note, however, with regard to this point, that it is clear that on the particular spot where the mine is situated the present surface of the granite is almost the same as that which existed at the time of the deposition of the Permo-Carboniferous sandstones. The rounded water-worn surface of the hard rock in the south end of the trench south of No. 4 shaft was even very probably worn to shape as we now see it by the waters of that distant period. Since then the granite has been covered with a great accumulation of later deposits, which have not been completely removed again till quite recent times. The outcrop of the lode is therefore substantially the same as when it was washed by the Permo-Carboniferous sea. During the ages while it was buried deep

under the thick strata of the coal measures and great flows of the Mesozoic lavas, it is possible that chemical changes may have gone on in the lode, leading to its enrichment in tin ore at its contact with the overlying rock. This far-fetched hypothesis seems to me the most plausible explanation that could be offered in this case of the existence of a rich "surface patch" with no good ore below it, and is only introduced to show how difficult it is to account for such rich pockets having any necessary connection with the accident of their being found at surface. It is true that rich bunches of ore have often been found cropping out at grass and have soon given out when sunk upon, but it is also true that in many instances further exploration has developed numerous other such ore-bodies at greater depths. When a surface patch is worked out it too often happens that the lode is thereupon abandoned as worthless, and in the multitude of such experiences it is often lost sight of that there are very many cases where perseverance has been well rewarded.

In a case like the Roy's Hill mine, where good tin has been found for a length of 350 feet, and where the large size of the lode bears witness to the strong mineral-forming action that has gone on, I do not think there is much reason for gloomy forebodings because the deeper shafts have not yet found much good ore. It may take some time and patience to develop further ore-bodies, but, in my judgment, there is every reason to go on working hopefully. The distribution of the tin will probably be found to be irregular and patchy, but a few good bunches would pay for a lot of dead ground. I should recommend that a main shaft be sunk near the middle of the known ore to a depth of, say 100 feet, and that the lode be then thoroughly prospected by driving along it and making numerous crosscuts. It should be remembered that the eastern wall has not yet been anywhere seen; and, though present appearances seem to show the ore to be best on the western one, it might not be so always. The good ore in hard rock in the trench south of No. 4 shaft shows that the tin is by no means confined to the contact with the sandstones. While sinking the shaft it would also be well, at the same time, to follow the outcrop of the lode still further by surface trenches, and to cut several to the eastward across the mass to the eastern wall, so as to determine whether there was not more tin-bearing rock not yet uncovered. The way the tin occurs in the similar Fly-by-night contact mass renders it likely that ore will thus be found. The formation is evidently a large one, and should be explored from the contact with the quartzites on the west side to the unaltered granite on the east, which has not yet been laid bare.

Mr. Henry Simpson, Manager of "The Roy's Hill Freehold Proprietary Company, Limited," the owners of the mine, has been good enough to give me the following statement of the ore sent away from it for reduction up to date:—

"A. 12 tons 10 cwt. treated at the Parke and Lacy Company's Works, Sydney, yielded 1 ton 17 cwt. 0 qrs. 13 lbs. concentrates, assaying 67.6 per cent. metallic tin, and 7 cwt. 1 qr. 22 lbs. assaying 69.0 per cent.

"B. 9 tons 16 cwt. 2 qrs. treated at the Clyde Smelting and Concentration Works, Sydney, yielded 3 tons 10 cwt. of concentrates, assaying 62 per cent. metallic tin.

"C. 4 tons 18 cwt. treated by T. Bateman, Launceston, with a 'Mudie' Crusher, yielded 1 ton 9 cwt. 3 qrs. concentrates, assaying 73.3 per cent. metallic tin.

"A. and B. were crushed by Huntingdon mills, and then passed over Frue Vanners. C. was crushed by 'Mudie' Crusher, and streamed in the ordinary way."

Parcel A. therefore gave a mean return of 17.8 per cent. of black tin, assaying 68 per cent. metal; that is, it contained 12.1 per cent. of metallic tin. Mr. Pilbeam, Manager of the mine, told me that there were two lots of ore, of about 8 tons and 4 tons weight respectively, treated by the Parke and Lacy Company, the first returning 23 per cent., and the second 9 per cent. of black tin. These agree fairly with the more exact figures of the Company's manager. The 8-ton parcel came from No. 2 shaft and trench, and the 4-ton one from No. 4 shaft and trenches.

Parcels B. and C. came from the same heap, from No. 3 shaft and stope. The yield from B. is equivalent to 35.6 per cent., which, at 62 per cent. metal, is equal to 22.1 per cent. of metallic tin. That from C. was 30.4 per cent. of black tin of 73.3 per cent. assay, equal to 22.2 per cent. of metal. The two tests gave, therefore, practically identical results.

On the mine there are about 15 tons of stuff raised that should yield over 20 per cent. of black tin, about 40 tons that might give 10 per cent., and over 100 tons that would probably yield 3 or 4 per cent. of black tin. Counting the unbroken ground shown in the plan, it would probably be fair to say that not less than 1000 tons of payable ore are "in sight." As there is no mill nearer than the Brookstead Company's one, which is on the other side of the St. Paul's River, it would be advisable for the owners of Roy's Hill to procure a small crushing-plant to enable this ore to be turned into money. Till more work has been done underground it would be as well not to put up a large or expensive mill.

A good supply of water for dressing purposes can be got from the Snow Creek. This is said to be a permanent stream all through the summer, and has every appearance of being so. When I saw it all the watercourses were in flood, and there were over 20 heads of water in the Creek. In the height of summer Mr. Pilbeam estimates that it carries 7 heads. From three to three-and-a-half

miles of race through easy country would bring water in from it twenty to thirty feet above the No. 2 shaft. In the flat at the foot of the spur on which the mine is situated this would give a pressure of 80 to 90 feet. By constructing dams in the Snow Creek it is probable that water enough could be stored for a pretty large dressing-mill, and in the wet season for power to drive it as well. In summer the aid of steam might have to be sought. As there are several considerable creeks in the neighbourhood, not to speak of the St. Paul's River itself, there should, however, be no great difficulty in getting water-power for all purposes, even for a fairly large mill, by going to the expense of some longish races and good-sized dams.

On the Roy's Hill Freehold there are some other places that might be prospected with advantage. On the east side of the valley of the Snow Creek, and about a quarter of a mile south of the main road, there is a large outcrop of micaceous granular quartzose lodestuff, often carrying tourmaline and containing some tin. This is a very large mass, the loose stone from it covering the ground for a length of about five chains and a width of quite three chains. It seems to run N. 70° to 80° W., but, as no walls are seen, this may not be its true course. I saw some nice specimens of tinstone in parts of this, though on the whole the stone seemed poor. It would be worth while trenching across it, however, to see if there were not richer and workable portions in it.

About a quarter of a mile from the eastern boundary of the estate, on the low hills to the west of the Roy's Lea Creek, there is another pretty large outcrop of stone very similar to the last, but containing more tourmaline. This is also tin-bearing, and should be further tested. Still another large lode of similar character is found on the top of the spur, just east of the eastern boundary of the estate in Crown land. A little work has been done here by a prospecting party, and some of the stone shows good tin. The lode is a very large one apparently, and runs N. 40° W. A tunnel could be driven into it along its course at a depth of over 100 feet below the top of the ridge. The stone seems poor on the whole, but may well contain payable portions which are worth looking for. This lode is a little N.N.W. from the workings of the old St. Paul's Tin Mining Company.

There does not seem to be much chance of finding payable alluvial tin on the Roy's Hill estate, as the valleys are nearly all filled with either the old Tertiary sediments or with more recent detritus from the formations on the range to the south, diabase greenstone, and coal measures rocks. There probably are deposits of alluvial tin in the St. Paul's River valley, deep below the surface drifts, but it is questionable whether these could be discovered and worked without very great expense.

I have the honor to be,
Sir,

Your obedient Servant,

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

The Secretary of Mines, Hobart.

