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REPORT ON THE BEN LOMOND DISTRICT.

Geological Surveyor's Office, Launceston, 5th May, 1892.

SIR,

I HAVE the honor to report having visited the Ben Lomond District, and made a general examination of the mineral areas taken up there for tin and silver mining purposes. My first visit to the district was from the 8th to the 15th of December, 1891; but as the Great Republic mine, the principal one in the place, was at that time full of water, due to repairs to the winding machinery being in progress, I again went to it on the 8th, 9th, and 10th of March, 1892. While sufficient time was taken to get a good general idea of the geology of the district and to fairly well examine the principal mineral-bearing ground, no attempt was made to lay down with accuracy the boundaries of the formations met with or to make any survey of the various lodes. A detailed examination such as would be required to do these things would consume a great deal of time, and does not seem to me to be at all necessary as yet, the amount of development done up to the present being very small. The general map forwarded with this report is therefore only a sketch one, to indicate broadly the general position of the various formations.

? south

The mines are all at the north end of Ben Lomond, lying on the slope extending from below the towering cliffs known as "The Butts," which form the highest point of the mountain, to the South Esk River at Avoca. From the valley of the Esk the ground rises rapidly to about 2200 feet above the sea level, at which height we come on a very noticeable terrace (see section herewith) of fairly flat ground of very considerable extent, reaching from the head waters of Gipps' Creek on the west to Story's Creek on the east, and averaging probably two miles in width. From the north side of this terrace the ground rapidly rises, getting steeper as we ascend, till on the talus of broken rock lying immediately at the foot of "The Butts" it is inclined at the angle of 30° to the horizontal. Finally, vertical cliffs up to 250 feet in height are met with, forming the northern edge of the table-land which lies on the top of the mountain at a height of slightly over 5000 feet above sea level.

Topography.

Southern?

A fairly good cart road has been made from Avoca to the Great Republic mine, and access from it to the other mining properties is pretty easy. It goes up the valley of the Castle Carey Rivulet, coming up on the terrace above mentioned on section 3520-87m. Here it crosses an old unformed road leading from the Rix Hill mines to those of Story's Creek. This old road connects near the Rix Hill mine with another track leaving the main road about four miles from Avoca and leading to the Ben Lomond, Great Republic, and Gipps' Creek mines, and to the Town Reserve lying at the foot of "The Butts." Between Avoca and the junction of the main road with this old track the ground is pretty flat, the valley of the Castle Carey Creek widening out and running flatter as it comes out on the flat valley of the South Esk.

Access.

The township of Avoca is situated on a patch of basalt of probably Tertiary age and of limited extent. It is similar to the other Tertiary basalts found in this Colony and in Victoria. For about a mile along the Ben Lomond Road after crossing the Esk we pass over clayey and sandy beds, which I have not examined closely, but which are probably part of the Tertiary deposits which extend up the valley of the South Esk for a long distance. Next diabase greenstone is met with. This is portion of a very extensive mass which bounds the mineral-bearing area on its western side, and connects with the great cap or boss of the same rock which forms the table-land on the top of the mountain. The old road to Ben Lomond above spoken of runs along the contact of this greenstone with the granite and carboniferous formations next to be mentioned. About a mile and a half from Avoca sandstones belonging to the lower beds of the coal

Geological Formations. Basalt.

Tertiary.

Greenstone.

Carboniferous.

(No. 79.)

Granite.

measures (permo-carboniferous) are come upon, and the road passes over these up to its junction with the old track, where granite comes in. This is a porphyritic granite composed of felspar, quartz, and mica, all well developed, but with the felspar (orthoclase) in much larger crystals than the other constituents. It, however, varies a good deal in different places both in composition and texture. In some parts of the district, as near the Great Republic mine, and again on the main road near where it crosses the Buffalo Creek, masses of quartz porphyry are seen in which the felspar is not in recognizable crystals, but forms the groundmass in which the crystals of quartz are studded. Mica in these rocks is in small quantity, absent, or micro-crystalline. In the Great Republic mine the granite country, which as a rule is coarse-grained and of the usual ternary type, is in parts hard, dark-coloured, and fine-grained, with occasional very large crystals of orthoclase up to two inches in diameter. The colour of the ordinary country granite of the district varies from grey to reddish-grey, and in general it is very similar to the granites of Mount Cameron, Mount Stronach, the Blue Tier, and the Freycinet Peninsula, with which it is probably contemporaneous. It forms the main mass of the country rock between Gipps' Creek and Story's Creek, and goes northwards close to the greenstone capping of the mountain, and probably extends underneath it. It is overlaid in parts by strata belonging to the coal measure formation, slightly inclined shales, mudstones, sandstones, and conglomerates, often highly charged with typical fossils of the permo-carboniferous system. These are met with in various parts of the district: on the main road from Avoca at about 1400 feet above sea-level, and thence to the top of the terrace at 2200 feet, in patches over various parts of the terrace, and at intervals along the course of Gipps' Creek. At the foot of the greenstone talus below "The Butts," sandstones and conglomerates of this system are found pretty regularly, and for some 300 or 400 feet up on the talus, occasional, though rather rare, blocks of sandstone are met with, showing that there is probably a considerable thickness of these beds lying up against or running under the greenstone of Ben Lomond. In this instance it seems highly probable that the greenstone had overflowed the sandstone beds to some extent rather than cut them abruptly off, for the curious step-like terrace seen in the section was certainly till quite a recent period covered by permo-carboniferous strata, and the high greenstone escarpment of "The Butts" is most likely due to the rapid erosion of these soft beds from beneath an overlying sheet of greenstone.

Carboniferous, &amp;c.

From a scientific point of view the coal measure strata of this district are worth a much more detailed examination than I have yet been able to make of them, as it is probable that they afford a very complete section from the marine beds of the permo-carboniferous formation to the mesozoic plant beds of the upper coal measures of this Colony. Highly fossiliferous limestones are found in Gipps' Creek; the mudstones of the head of the Castle Carey Creek are also rich in fossils (marine); in the sandstones just north of Section 703-91M fragments of vegetable remains, too broken for recognition, were observed; in the mudstone conglomerate near the Story's Creek Company's small dam coaly fragments of plant stems were pretty plentiful, and higher up Story's Creek inflammable shale has been obtained; and, finally, at a height of about 4000 feet some seams of coal, with the characteristic mesozoic fern fossils accompanying them, have been discovered. Mr. R. M. Johnston also informs me that shales containing the characteristic *glossopteris* and *gangamopteris* of the lower coal measures have been collected near the head of Gipps' Creek. It would seem, therefore, that the section here revealed ought to give a fairly complete sequence of the beds from the base of the lower coal measures to at least the coal horizon of the upper coal measures. The interesting problem of the age of the Ben Lomond greenstone would probably be solved by a detailed examination of these occurrences. While there is a certain amount of evidence that the greenstone is younger than the permo-carboniferous formation, it is not so certain that it is also younger than the mesozoic or upper coal measures; and, as has been frequently pointed out, the relations of the diabase greenstones to the coal measures of this Colony have a most important practical bearing on the extent and value of our coal deposits.

The greatest thickness of carboniferous strata in this district is exposed in the patch at the head of the valley of the Castle Carey Creek. Here there are probably not less than 600 feet of them in vertical thickness. On the terrace, however, they appear to form only a very thin coating, through which the underlying granite has been exposed in many places. In the vicinity of the old Tasmania mine, for example, nothing but granite is seen, the coating of sedimentary strata having been entirely removed by denudation. Traces of the former presence of these beds at no distant time are, nevertheless, to be seen in many parts of the flat ground, even where no part of them is seen *in situ*, the surface being strewn with waterworn rounded pebbles of metamorphic slate, quartzite, schist, quartz, and granite, which at first sight lead one to suspect that deposits of alluvial drift exist. They are, however, in reality derived from beds of soft mudstone conglomerate, small patches of which may be seen still undisturbed in various places on a ridge to the west of the old "Clunes" mine, near the Eastern Marsh, on the flat between Nesbitt's and Story's Creeks, and elsewhere. A very good specimen of them is to be seen in a shallow shaft sunk not far from the Story's Creek Company's small dam, just at the foot of the greenstone talus. Here the conglomerate appears as a hardly at all indurated mudstone, full of thoroughly waterworn pebbles of quartz, metamorphic sandstone, and granite, exactly similar to the rounded stones found scattered over other parts of the terrace. It may be here remarked that, though immediately under the talus of greenstone from the high cliffs of the top of the mountain, I could find no pebbles of greenstone in the conglomerate, which goes far to prove that the greenstone is of later age. In none of the other places where conglomerate was found could I find any pebbles of greenstone in it either, though, in most instances, close to existing large masses of that rock.

The elevation of the sedimentary beds to such heights as where we now find them has probably been performed by means of a series of faults. The sandstones found at the foot of the mountain are probably of the same horizon as those at the foot of the talus of greenstone below "The Butts," some 1700 to 1800 feet higher. Whether this dislocation was produced by one or by more than one fault no evidence has yet been collected to show, but, most probably, more than one would be required. A small fault is visible in an

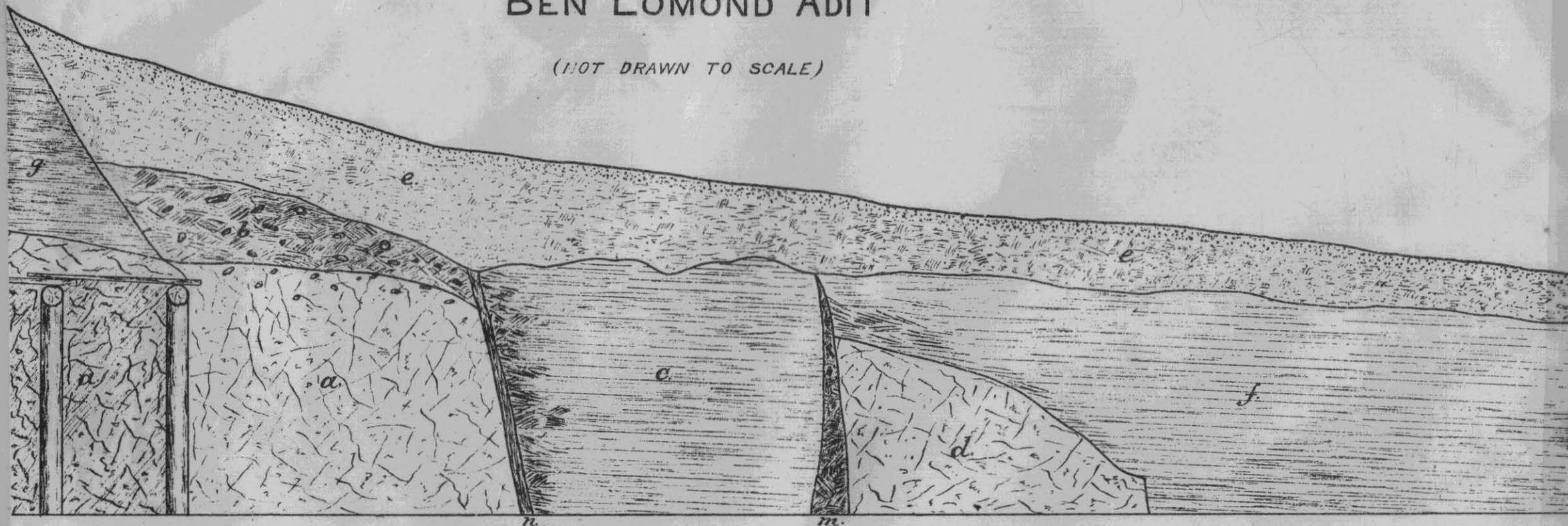
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## SECTION

SEEN IN SOUTH SIDE OF APPROACH TO THE

## BEN LOMOND ADIT

(NOT DRAWN TO SCALE)



- a. Granite, containing rounded pebbles of quartz and quartzite near contact with b, also broken shale.  
 b. Broken Shale, with rounded pebbles.  
 c. Shale, broken near contact with n.  
 d. Granite.  
 e. Surface soil, clay and gravel.  
 f. Shale, a little broken near contact with d.  
 g. Shale, seen over top of tunnel, same as c. and f.  
 m. Clayey contact mass, fragments of shale and blue clay.  
 n. Clayey vein at contact of a. and c.

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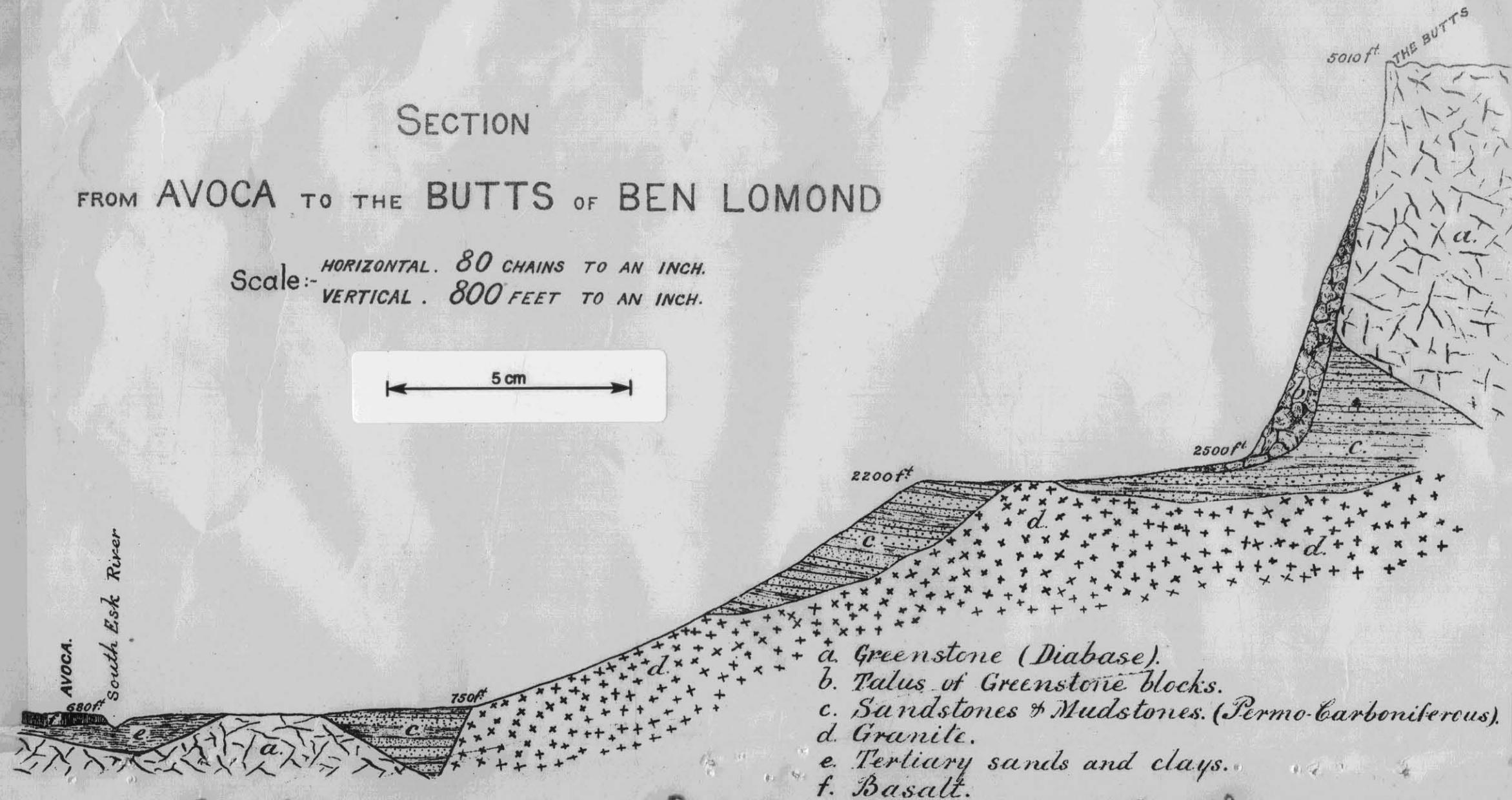
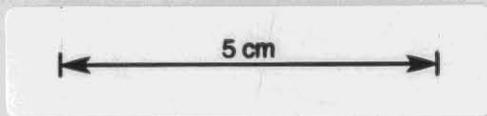
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21.

# SECTION

## FROM AVOCA TO THE BUTTS OF BEN LOMOND

Scale:-  
HORIZONTAL. 80 CHAINS TO AN INCH.  
VERTICAL. 800 FEET TO AN INCH.

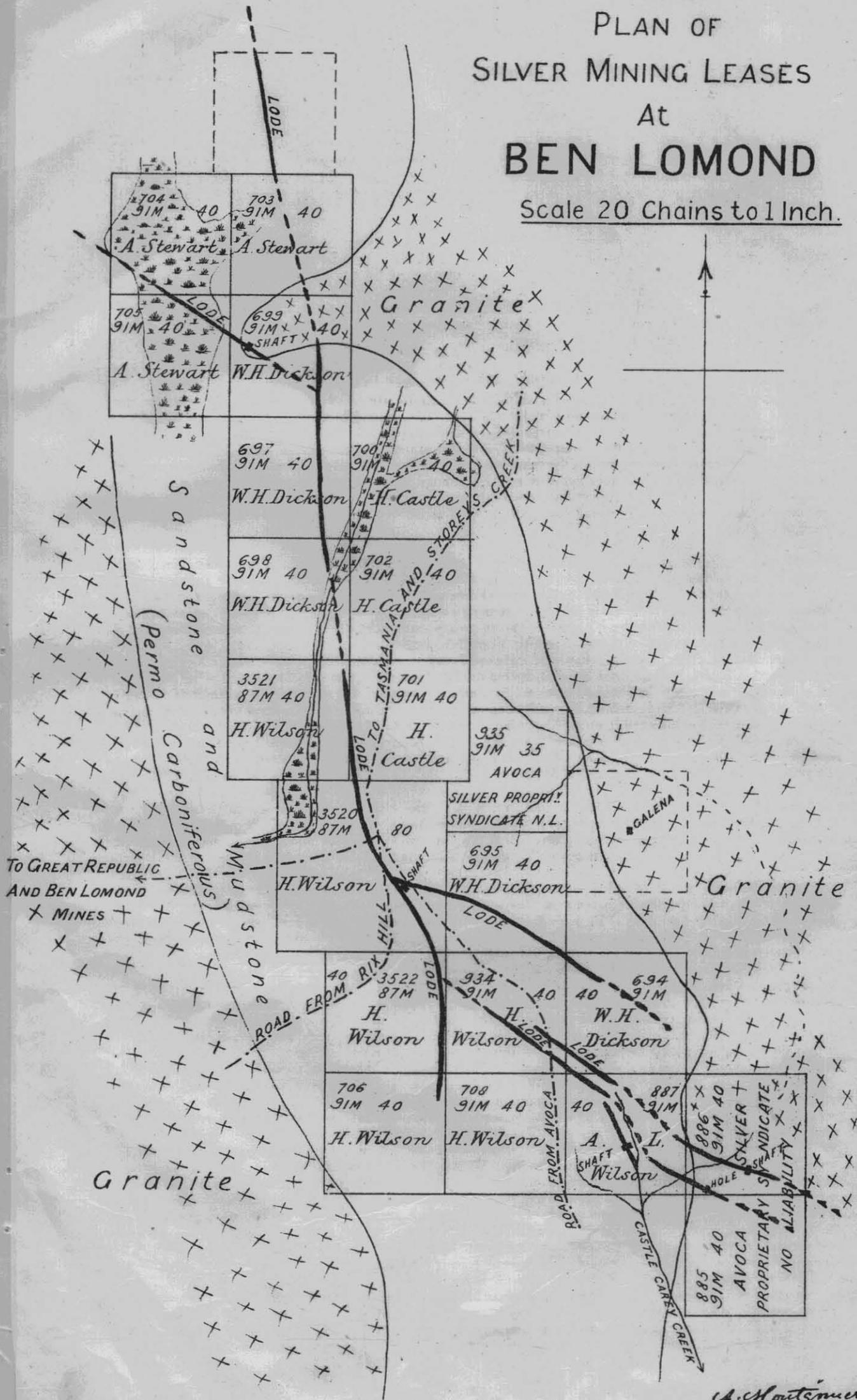


- a. Greenstone (Diabase).
- b. Talus of Greenstone blocks.
- c. Sandstones & Mudstones. (Permo-Carboniferous).
- d. Granite.
- e. Tertiary sands and clays.
- f. Basalt.

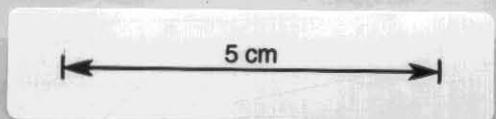
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# PLAN OF SILVER MINING LEASES At BEN LOMOND

Scale 20 Chains to 1 Inch.



*Ch. Montgomery  
Geo. L. Searcy*



angle of the road leading up the valley of the Castle Carey Creek, near the bottom of the large patch of coal measures beds there existing: the sedimentary beds are seen to be cut short off by a nearly vertical granite wall. It is possible that the faults may have some connection with the mineral-bearing lodes of the district, and, even if not, they deserve study from a mining point of view, as being likely to cut off any lodes they may encounter in their course.

Another formation has yet to be mentioned before passing on to a consideration of the mineral Silurian deposits, namely, ancient metamorphic sandstones and slates, highly inclined as to bedding, and much seamed with quartz veins, found in the vicinity of the upper part of Story's Creek. No fossils were observed in these, but it is most probable that they belong to the same series as those further eastward at Mangana and Mathinna, and are of Silurian age. Silurian slates are also said to occur near the head of Gipps' Creek, a locality which I did not visit. Fragments of this formation are very abundant in the permo-carboniferous conglomerates above mentioned.

#### SILVER MINING AREAS.

A large number of mineral sections have been taken up for silver mining purposes between the head waters of the Castle Carey and Buffalo Creeks and near Rix's Hill. They fall naturally into two groups, those in granite and those in the permo-carboniferous sandstones. The latter are nearly all together in a group, at the head of the Castle Carey Creek, and are shown in the smaller plan accompanying this report, which is taken from one kindly furnished to me by Mr. Frank Reed from his own surveys. As shown thereon, several lines of lode run through the sections, and all are very similar in character. They are well defined, and readily traceable on surface for long distances, the outcrops frequently forming distinct outstanding lines of rock. By describing them in some detail their characteristics and probable value may be explained.

Section 3520-87M.—This and the adjacent Section 3521-87M are held by the Avoca Silver Proprietary Syndicate, of Melbourne. Two lines of lode seem to unite in the former section, and near their junction a shaft has been sunk to a depth of 88 feet in hardish mudstones and sandstones full of the characteristic fossils of the marine beds of the carboniferous system (*Fenestella*, *Protoretzpora*, *Spirifera*, *Stenopora*, &c.). At the bottom of the shaft a drive was put in to the south-east a distance of some 16 feet, cutting the lode about 8 feet from the shaft. It consists mostly of rather spongy silicious oxide of iron (brown hematite) with a good deal of fragmentary country rock enclosed in it. A sample taken by picking a large number of small pieces of the lode-stuff from the heap on surface, was sent for assay to Mr. W. F. Ward, Government Analyst, in Hobart, but did not contain any metal of value. On surface the main lode is easily followed along the line laid down on the plan: it generally is very full of fragments of country rock, but in places is fairly free from these, and consists then almost entirely of siliceous brown oxide of iron. The outcrop varies in width up to 10 or 12 feet, and the lode, if opened, would probably be found to average 6 or 8 feet in width, or perhaps more. The trend of the lode is on the whole about N.N.W., and its underlay is only slight, and towards the N.E.

Sections 695-91M and 694-91M.—A little to the east of the shaft the second lode, shown on the plan as joining the first near it, crops out very plainly and may be traced E.S.E. through Section 695-91M into 694-91M. It consists of a breccia of fragments of the country fossiliferous mudstones cemented together by brown oxide of iron and some quartz, and often contains small crystals of quartz.

Sections 886-91M and 885-91M.—In these a change of country is met with, granite coming in. The junction of this with the fossiliferous mudstones is rather obscured by surface detritus through which the lodes are not clearly traceable; still two lodes which are well seen in the granite appear to be identical with ferruginous outcrops in the mudstone country in Section 887-91M, from which it would appear that they penetrate both sorts of rock, a fact which may prove to have an important bearing on the prospects of these lodes. Two small prospecting holes have been sunk in Section 886-91M, one about six chains south of the centre of the section, and the other near the south boundary about three chains from the S.W. corner. The former is said to be about 30 feet deep, but was full of water when I saw it. A lode about 14 inches wide, striking N. 55° W., underlying a little to N.E., consisting of a mixture of brown oxide of iron, quartz fragments, and siliceous cementing material, is seen here, and may be traced to the south-east to the top of the ridge on which the section is situated, and even further.

Tin is reported to have been found in this lode where picked up again farther to the south-east, but this I cannot vouch for. Samples for assay taken by me from the stuff at the shaft yielded no metal of value when tried by Mr. Ward. The second prospecting hole on this section is only a few feet deep; it reveals a large lode of quartz over six feet in width and of banded character, consisting of two bands of solid quartz one foot and two feet in thickness, with one foot of rubbly quartz between, and rubbly quartz again on the hanging wall. Dip S.W. about 76°. The quartz did not appear "kindly," and as far as I could learn neither gold, silver, nor tin has yet been found in it. About 20 feet south of this quartz there is a large strong outcrop of siliceous oxide of iron carrying some spots of white quartz. Loose stones from this and the quartz reef strew the slope down to the creek. Probably both belong to one large lode. Being in granite country the lodes in this section are to my mind better worth testing than those in the sedimentary strata. As the ground rises rapidly on the east side of the Castle Carey Creek, it would be easy to prove both of them by driving on their course from the creek level.

Section 887-91M.—It is possible that the lode being sunk on (February, 1892,) by the Castle Carey Company on this section, is connected with the last-mentioned lode. A shaft has been sunk on it to a depth of about 40 feet in veinstuff, consisting of fragmentary country rock, brown oxide of iron, and quartz. Water coming in too strongly when the level of the adjacent creek was reached, the work had to be abandoned.

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The outcrop is very well defined, and strikes N. 25° W. In the shaft the underlay was found to be 1 in 15 to the north-east, and the width of the lode over four feet. The veinstuff was all oxidised right down to the bottom of the shaft. This lode being strong and well defined would be a good one to trace into the granite, which is not far distant from it, in order to see if it would be richer in metal in the more favourable country. In the shaft it has been worthless.

Sections 694-91M and 934-91M.—The two lodes shown on the plan passing through the S.W. corner of Section 694-91M are traceable as lines of loose stones of ferruginous brecciated material. The more northerly one is seen crossing the road as a line of ferruginous fractured country rock rather than distinct lode stuff, about one to two feet wide. Both seem rather small, and require to be trenced upon so as to be cut in solid country, and then prospected by sinking on them or driving in from the creek.

Section 699-91M.—Following the lode in 3520-87M northwards along its course, it is found crossing the road to the Great Republic mine as a band of ferruginous stained country rock, and is there traceable by loose surface stones into Section 699-91M, as shown on the plan. In going over this line I found it rather difficult to follow the outcrops, and it seemed probable that there was more than one line of lode, perhaps two or three close to one another and nearly parallel. The line on the plan indicates the general position of the outcrops.

Section 703-91M.—On the north boundary of Section 703-92M a very distinct outcrop of ferruginous lode-matter of similar character to those before described is met with, very probably belonging to the same line of lode or fracture as the foregoing, corresponding fairly well both in position and direction. The outcrop is traceable northwards for about 20 chains, and stands out boldly in several places. As a rule it is more ferruginous and contains less country rock than those hitherto spoken of. A large number of fragments from different outcrops were sent to Mr. Ward for assay, but did not contain any metal of value. The lode has not been worked upon at all, but appears to be from three to eight feet wide. The country is mostly hard mudstone and sandstone, with some conglomerate containing rounded pebbles of quartz and Silurian slates. A few indistinct impressions of plant stems were observed in the mudstones. I do not think that the permo-carboniferous strata are here more than 100 feet thick at the very most, as the granite appears quite close by. Here, too, it is most likely that the only hope of finding payable ore in the lodes is to follow it down into the granite country.

Section 705-91M.—On Section 699-91M a north-westerly lode has been discovered, and traced as on plan, into 705-91M. A tongue of granite here shows through the sedimentary strata, and a small shaft has been sunk almost at the junction of the two formations. The outcrops show the lode to be from 1 to 4 feet in thickness, but it may, of course, prove much larger when properly laid bare. The shaft was full of water, preventing examination. The lodestuff thrown out was mostly siliceous brown oxide of iron, containing no metal of value according to Mr. Ward's assay of the samples taken by me.

As will be seen from the above description, there is a great similarity in all these lodes traversing the permo-carboniferous mudstones and sandstones. They consist mainly of angular fragments of the country rock, cemented together by brown oxide of iron, clayey matter, and silica. The lodestuff is usually loose and spongy, and gives one the impression of having been formed at a comparatively recent date. There is no doubt that the lodes represent definite lines of fracture in the country rocks, and very probably, if opened up, it would be found that there is a certain amount of displacement in the beds traversed, those on one side being faulted down a greater or less distance. The lines of fracture having been loosely filled with broken country rock have been channels through which water carrying iron and silica in solution has percolated, depositing the present cementing material. Possibly, in the first instance, the iron was deposited as pyrites. Near the Great Republic mine, close to the track to Gipps' Creek, and on the Ben Lomond Company's property, pyrites and quartz lodes are found traversing granite, and these in their oxidised outcrops rather closely resemble the foregoing lodes.

In the prospectus of the Avoca Silver Mining Company, five assays of gossan from the lodes on the Company's properties are quoted, two of which gave good returns, 48 oz. 3 dwt. 16 grs. and 64 oz. 10 dwts. 8 grs. of silver respectively. The first was described as "quartz and iron gossan, with a little carbonate of lead," the second as "iron ore." During all my examination of these lodes I did not see one particle of carbonate of lead, nor did any of the assays of samples taken by myself, and analysed by the Government Analyst in Hobart, yield either lead or silver.

In the present unopened condition of the lodes it is hazardous to offer an opinion as to whether any metal of value will ever be found in them or not. The country rock in which they lie has not yet been proved to carry payable lodes anywhere in this Colony. Silver-lead lodes have been found in various parts of the world in strata much younger than our permo-carboniferous system, and there is no reason for anyone to say that it is impossible for these also to contain ore; still all the silver-lead lodes of this Colony have hitherto been found in the Silurian and Plutonic rocks, and very strong indications of the existence of the metals would have to be present before we should expect them in so much younger a formation. The most favourable feature, to my mind, in these lodes, is the almost certainty that they pass downwards into the granite. This has been proved to carry silver, lead, and tin in this same district, and it is quite possible, and not unlikely, that in it the lodes will carry these metals. The fact that the lodes above described also are on the whole parallel to the known metalliferous veins of the district leads us to have a certain amount of hope for their future, though it must be remembered against this that there is yet no evidence, except the similarity of strike of the sets of veins being contemporaneous.

Efforts have been made to form large companies in Melbourne to work these lodes, and a ridiculously high value has been placed upon them. If the money already spent in trying to float these companies and

printing glowing prospectuses had been put into work on the ground instead, it would long ago have been proved if there was anything to mine for, a question at present extremely doubtful. I might sum up the prospects thus:—There are lodes, of fair width, definite and persistent over very considerable distances; it is very doubtful if any silver or lead has yet been found in them; they are in country rock which has hitherto never been found to contain silver ores in this Colony; they almost certainly go down into granite country, which has been proved to contain lead, silver, and tin in this very district; there is a certain amount of probability that in the granite they will contain these metals; they require to be prospected to find them; and the possibilities of finding ore seem to me sufficient to warrant a small expense in so prospecting.

Coming now to the ground taken up for silver-mining purposes in granite country, we find that the prospects are much more hopeful. Several of the sections once taken up have, however, been forfeited, and are not now held by anyone. Sections 935-91M and 695-91M comprise part of an old section 1637-87M, which has been given up. At the time of my visit a notice of application to lease 40 acres, due east and adjoining Sections 935-91M and 695-91M, was posted near an old working on this forfeited section. This hole was partly full of water and could not be entered, and the direction of the lode laid bare in it could not be ascertained with any approach to certainty. It is a large one, consisting of quartz impregnated with galena, blende, copper pyrites, talc, and fluorspar. The vein stuff is very hard, and, though some of it contains a good deal of galena, is, as far as seen, too poor to work. It much resembles some of the hard stuff in the Rix Hill lode. Though poor where it has been struck, it seems to me that this lode is well worth tracing and proving by trenches along its line of strike. It is highly probable that in places it will be found to contain more metal, and particularly tin ore. From the size of the lode as exposed in the cutting, it is probably not less than eight feet thick. A strong lode formation of this size may well be expected to prove permanent and, in parts at least, payable.

Abandoned Sections, 1971-87M, 1972-87M, 2062-87M.—On one or more of these forfeited sections a very interesting occurrence of galena is to be noted, namely, as an impregnation through granite. The rock is here almost altogether composed of felspar, quartz and mica being hardly at all distinguishable. The felspar is of whitish, pink, and greenish colour, with large porphyritic whitish crystals standing out from the mass, and the weathered portions are much blackened by dioxide of manganese. A hole about 20 feet deep has been sunk in the rock, proving it to be very hard, and likely to be expensive both to mine and to crush. Impregnated through the stuff is a good deal of galena with generally a large admixture of blende. This occurrence is of interest as showing the existence of lead in the country rock, though I do not think that any of the stuff so far exposed is nearly rich enough to pay for treatment. I could not detect that there was any dyke or intrusive mass of this very felspathic rock penetrating the ordinary granite of the district; it rather appeared to become more quartzose and gradually merge into the regular type. A little to the east of the shaft some softer rock has been cut in a shallow trench, and it might be possible to sink here more easily; but I am rather inclined to believe that the softness is only due to superficial and atmospheric influences, and will not extend to more than a few feet in depth.

*Scott's Find.*—Some 14 or 15 chains N. 15° W. from these workings the same galena-bearing felspar porphyry is seen again, though ordinary granite intervenes between the two places. Here, too, the rock seemed rather a felspathic segregation than an intrusive mass. A trench about five feet deep has been sunk on a soft portion of this by Mr. Scott, prospector, of Ben Lomond. The soft material excavated contains much talc or chlorite, partly decomposed felspar, oxide of iron, kaolin, and some quartz, and may perhaps prove to be part of a lode traversing the porphyry. On the joints crystals of cerussite (carbonate of lead) are pretty plentiful, and a good deal of galena is seen on breaking the more solid lumps. The appearance of the stuff is, however, deceptive, as it yields on concentration a much smaller percentage of galena than would be expected from looking at it. Some of the best-looking pieces collected by me were sent to Mr. Ward, Government Analyst, in Hobart, with a request that he would determine what percentage of concentrates could be obtained by washing, and their value. He reports:—"Sample B, after concentration by washing, yields galena and blende, &c., equal to 2.1 per cent., containing 23.8 per cent. of metallic lead, and silver at the rate of 11 oz. 8 dwt. 16 gr. per ton of concentrates. No gold is present in this sample." From this it appears that not only is the percentage of galena in the stuff small, but it is also poor in silver when obtained. The amount both of lead and silver is nevertheless very noteworthy for a country rock, and gives good hope of finding rich deposits in any lodes that may in time be found to traverse it. The attention of prospectors should be directed towards tracing any veins that may appear in the country round about into this proved metalliferous rock, which would be very likely indeed to enrich them greatly. It is also worth while finding out if the felspathic mass is or is not an intrusive dyke. Should it prove to be one, there would be considerable probability of finding contact lodes along its edges.

*Rix's Hill Mine.*—The most important discovery of silver ore yet made in the Ben Lomond District is on Section 1191-87M. Here blocks of galena weighing several hundredweights and of high assay value have been obtained. There has been much controversy as to the prospects of this mine and the direction in which the lode is running, and there is here a problem which requires well directed work for its satisfactory solution. A shaft and irregular open working have been made two chains south-east from the centre of the section, the open working forming an irregularly circular hole 8 or 9 feet deep and about 15 feet in diameter, at one side of which the shaft has been sunk to a depth of 33 feet from surface. From the bottom of the shaft some 15 feet altogether of driving had been done in different directions. The open working used to be drained by a deep trench, but this is filled up with rubbish and could not be examined, which is unfortunate, as it was likely to have thrown light on the course of the lode. The rock showing on all sides of the open working is lodestuff consisting of rather hard quartzose granular veinstone impregnated with talc or a hydromica, and some kaolin. Much cassiterite (tin ore) occurs through the stuff, and in the stone thrown out of the excavation I very soon picked out a large number of pieces that would be highly

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payable if obtainable in quantity. The tin ore is in fine grains, and generally appears to be richest where there is much green talc in the stone, specimens of which may be said to consist almost wholly of these two minerals. A little galena, blende, and copper-pyrites are occasionally visible in the veinstuff, but not enough to be of themselves worth more than passing notice. Running through this lode-matter, however, in flattish irregular masses are numerous strings and veins of hard glassy-looking quartz, often in very large crystals, and in this quartz, and more especially immediately round it, galena, copper pyrites, and black blende (marmatite) occur freely, and several tons of highly payable ore are reported to have been won from the workings, small as they are. Much of the copper pyrites is altered to and coated with indigo copper. A careful examination of the workings, and conversation with Mr. Briggs, who was at the taking out of the ore, led me to the conclusion that the veins of quartz and associated sulphides had no regular course, but lay in irregular patches of very variable thickness and extent through the rest of the lode-stuff. They are evidently of later formation than the bulk of the lode, bunches of talcose tin ore being often seen to be clearly cut through by the veins of glassy quartz. It seems evident that after the filling of the lode with quartz-carrying talc and tinstone it has been shattered and fissured, and the crevices have been filled with clear quartz and sulphides of lead, zinc, copper, and iron. The evidence of this later origin of the quartz and sulphide bunches seemed to me very conclusive. In the small drive eastward from the bottom of the shaft the country granite is struck, forming a well-defined almost vertical wall, separated from the lode-stuff by a clay selvage or flucan. The wall has a very slight underlay to the eastward, and strikes north and south, but has only been laid bare for about 4 feet in length. It is so well defined, however, that I have no doubt as to its being a true lode wall.

In order to cut the lode at a lower level, an adit has been driven 180 feet N. 21° E. through granite country to a point almost immediately under the shaft. The Mining Manager, Mr. Savage, told me that the adit was 65 feet below the top of the shaft, but according to my aneroid the difference is only 50 feet. The last 25½ feet of the drive are through lode-stuff similar to that seen in the open working. The western wall of the lode is struck at an acute angle, and, as the drive has been continued straight on, it passes diagonally across the lode, and not at right angles through it. The western wall is not quite so well defined as the eastern one seen in the shaft, the selvage not being so distinct. By observing the marked difference between the lode-stuff (which has, however, a somewhat granitic appearance) and the country granite the division is easily found. It strikes N. 10° W., and has a very slight underlay to the westward. The mean strike of the eastern and western walls as observable in the workings is, therefore, N. 5° W., and the lode can have little, if any, underlay. In this connection it is important to notice that lode-stuff of very similar character has been got in a trench seven chains north from the shaft, the line connecting it with the latter bearing N. 5° W. The surface of the ground being much covered with superficial granite debris, it is impossible to actually trace the lode from the shaft to the trench, but the bearing of the connecting line agreeing with the mean bearing of the walls of the lode, it is most probable that the latter continues right along it. The idea has been generally held that the course of the lode is about W.N.W. and E.S.E., but from the facts stated it appears certain that its course is only a few degrees to the west of north. The lode stuff on the western wall consists of granular quartz with talc and kaolin, carrying a little disseminated galena, marmatite, and pyrites, and very little tin ore. On getting further into the lode, however, much better tin ore was obtained, and the last 10 feet of the drive passed through some very rich stuff. Three or four tons of good ore were won here in making the drive. In the face, which has not gone far enough to cut the eastern wall of the lode, more marmatite and copper pyrites were showing at the time of my visit than had been met with previously, and it seems likely that on the eastern wall, which would be reached in a few feet further driving, more sulphide ore would be obtained. The owners, however, for some reason or other ceased working without penetrating to the eastern side of the lode. Measured at right angles to its course this must be some 16 or 17 feet wide. It is a very great pity that work was stopped without going a little farther. The quantity of tin ore in the stone is quite sufficient to justify going on with the driving; in fact, if the stone continued of the same richness it seemed to me, from such judgment as could be formed by the eye alone, without actually crushing and washing off large quantities of the stuff, that it was highly payable. With a wide lode like this, in solid country, working should be cheap; and though the adit commands only some 50 feet of "backs" at the shaft, going northward on the course of the lode the ground rises, and at the crown of the ridge—say six chains north of the shaft—there would be between 110 and 120 feet of "backs," and going over the ridge a deeper adit could be driven along the lode from the deep valley in Warner's section, 3365-87m. The stone in the trench before mentioned, seven chains north of the shaft, appears to be worthless; but the lode has not been cut through, and it may be as in the adit poor on one wall and good on the other. The quantity of tin ore seen in the adit and the open working makes me have no hesitation in saying that this lode well deserves a thorough trial, there being every reason to hope for a payable mine being the result. This, too, is having regard only for the tin, quite outside of any argentiferous lead ore that might be obtained as well.

About 50 feet N. 75° W. from the shaft another lode has been struck in a trench, a fact which has had much to do with the belief that the main lode ran W.N.W. and E.S.E. The strike of this is, as well as I could ascertain it from the short and rather poor wall exposed, N. 75° W., and it must, therefore, run against or pass through the main lode almost at the shaft. It appears to dip about 65° to the S.W., and consists of quartz and talc—very like the vein-stuff of the main lode—containing impregnated specks of galena and copper pyrites, but no tin ore as far as I could see or learn. The hanging wall is not seen, and the thickness of the lode is not, therefore, ascertainable, but it cannot be less than three feet nor probably more than eight feet. This lode may have some connection with another one found in section 1520-87m, towards the south-east corner of which some very good specimens of tin ore, composed of small crystals of cassiterite, studded through somewhat cellular and granular talcose quartz, have been picked up along a line running N. 65° W. The veinstone is very similar to that in the workings of the shaft and adit, but is more weathered. Most of the stones, though often very large, appear to be loose, and the lode, of which they are fragments, has not yet been cut in the solid ground; but there can be no doubt as to its existence in the neighbourhood of the line of loose blocks. Hardly any work has been done in the way of trenching for

# GREAT REPUBLIC MINE

SCALE 50 FEET TO AN INCH

CROSS SECTION

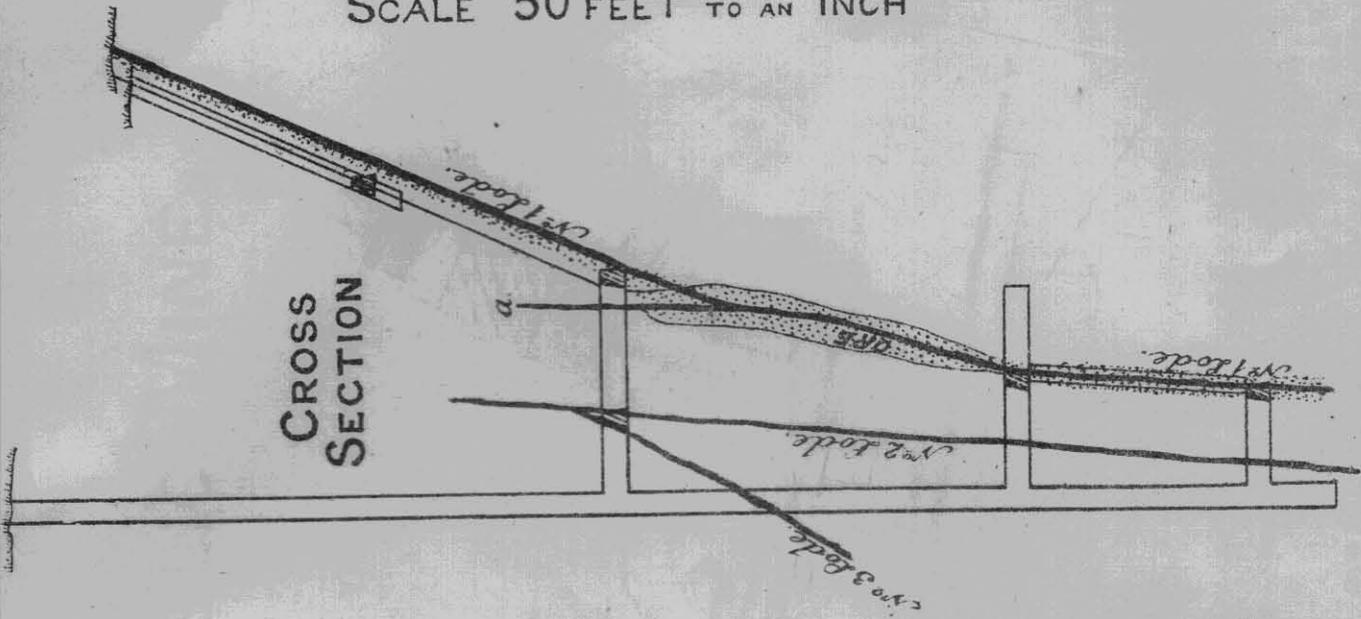
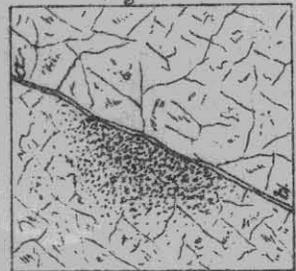
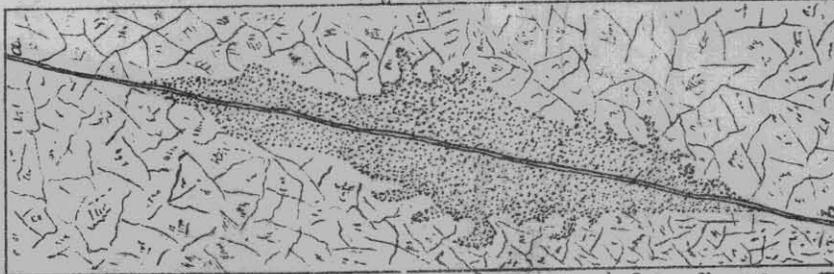


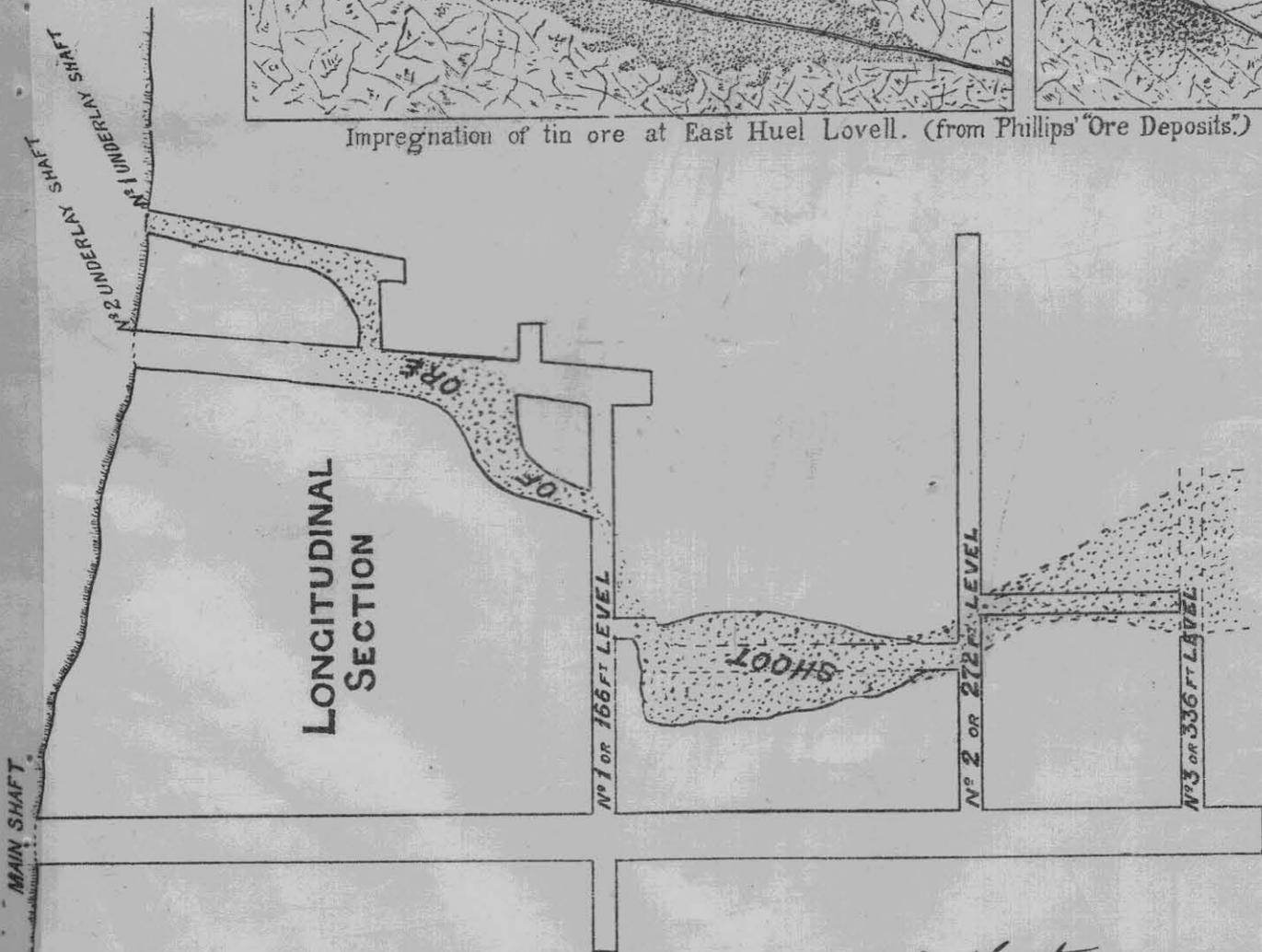
Fig. 40.

Fig. 41.

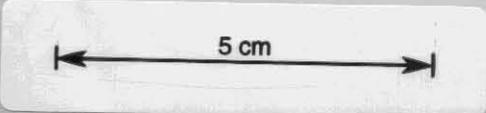


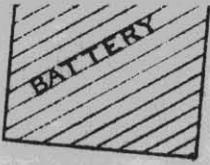
Impregnation of tin ore at East Huel Lovell. (from Phillips "Ore Deposits".)

LONGITUDINAL SECTION



*B. Montgomery*  
*Geological Surveyor*



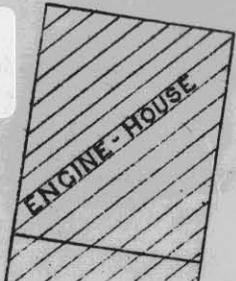
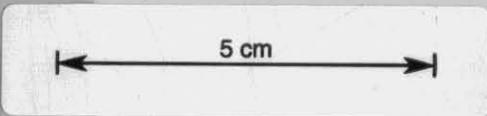
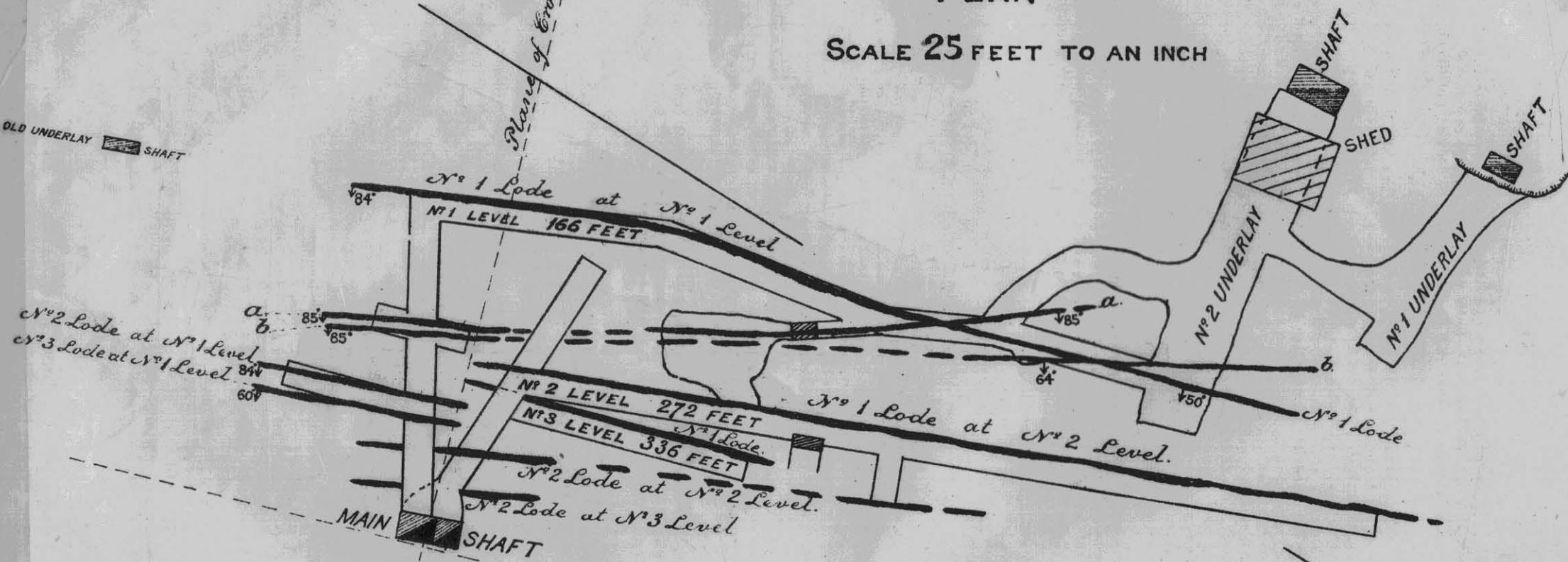


# GREAT REPUBLIC MINE

## PLAN

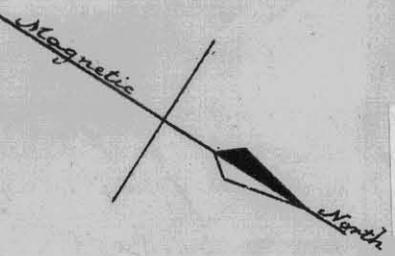
SCALE 25 FEET TO AN INCH

OLD UNDERLAY SHAFT



A. Montgomery  
Geological Surveyor

Plane of Longitudinal Section N. 18° 30' W.



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this lode, which is surprising, as many of the specimens are rich enough to make it well worth searching for. The position of this lode is considerably to the south of where it should be expected, if it were the same as the foregoing cross-lode at the shaft; but there is, nevertheless, a good deal of likelihood of their being identical. If not, they must be approximately parallel.

A good deal more work will yet require to be done before it is clear to which of the lodes that run into one another at the shaft the silver-lead ores and other sulphides belong. As above remarked, the quartz veins carrying these sulphides in them and on their margins are very flat-lying, irregular, and variable. They seem to me, however, rather to run across the main lode than with it, and they may be connected with the cross-lode described, or it is even possible that there may be a third lode crossing and shattering both this and the main one. Efforts should be made to ascertain the relation; and with the mine in its present state, with the dead-work of driving an adit through the hard granite country all over, the action of the owners in abandoning work without seeing what was in the lode they had struck with so much pains can only be described as pusillanimous. Very little work is now required to definitely settle the question of the course of the lodes and the mode of occurrence of the silver-bearing sulphides. It would be advisable to continue the adit to strike the eastern wall of the main lode and then drive along it for some distance. A cross-cut should be put in to where the cross-lode strikes the main one, so as to ascertain if the two form a junction, or if one cuts through or is faulted by the other. Two or three months' work ought to be quite sufficient now to show if the mine is worth going on with, as there is every reason to believe it is.

C. R. Foster's Section, 3505-87M.—A lode of considerable interest is seen in this section, a few chains west of the Rix's Hill Mine. It is mainly composed of breccia, of country rock, sandstone, and slate, with occasional rounded pebbles probably derived from conglomerate beds, all cemented together by siliceous brown oxide of iron and kaolin. The fragments of country rock at this point are mostly derived from the permo-carboniferous strata, though I noticed also an occasional fragment of granite. The same lode is also seen again close to the old road at the head of what is known as the "Black Pinch," in section 1842-87M, where it contains a larger proportion of fragments of granite, as well as slate, sandstone, quartz, kaolin, and oxide of iron. I took samples for assay from Foster's section, but they proved valueless when tested by Mr. Ward. The bearing of the outcrop here is N. 15° W., but the lode appears on the whole to have a N.N.W. course, as it is said to be traceable for about ten miles along the contact between the diabase greenstones and the granite formation. The ferruginous outcrops are often 10 to 12 feet wide. What is probably part of the same lode is seen on the hill west of the old "Clunes" mine workings, but is there mainly made up of mudstones hardened by infiltration of silica. There can be little hesitation in classing this as a "contact lode" formed by the breaking of the diabase greenstone through the older formations. The presence of fragments of the sandstones of the coal measures in the lode-stuff in Foster's section and at the "Black Pinch" where these do not occur *in situ*, the country being all either greenstone or granite, goes to prove that they at one time overlaid the granite, and have been removed by denudation. If the lode owes its origin to the eruption of the greenstone, as is most probable, the presence of these sandstone fragments in such quantities in the vein-stuff of this contact fissure goes far to prove that the diabase is younger than the coal-measure rocks. This lode is in its main characteristics similar to those in the sections at the head of the Castle Carey Creek previously described, and is fairly parallel to the main line of lode there. It is worthy of remark, too, that most of the lodes of the entire Ben Lomond District have a northerly to north-westerly bearing, whether carrying tin ore or otherwise.

Besides the occurrences of silver or supposed silver lodes above mentioned, there are reported to be several other ferruginous veins discovered in various parts of the district, some in granite, some in the coal measures, on which next to nothing has been done, and which I did not examine.

*Tin Mining Areas.*—We now pass on to a consideration of the ground taken up for tin-mining purposes, all of which is in the granite formation except the Sections in the neighbourhood of Story's Creek, many of which are on Silurian slates and sandstones.

The Rix's Hill Mine, which is much more a tin mine than a silver one, has been already described.

The principal mine now working in the district is that known as "The Great Republic," and is the most important as being the one which has yielded the largest quantity of ore and been sunk to the greatest depth. A plan and two sections (cross and longitudinal) of the workings are attached for the purpose of illustrating the remarks to be made on this mine. These, though approximately correct, are not altogether from actual survey, being taken as far as it went from a survey by Mr. G. T. Eddie in January, 1890, and brought up to date by means of rough measurements only, with hand compass and tape, which cannot pretend to accuracy. They are, however, sufficiently correct for the purposes of this report.

The Great Republic.

The ore cropping at surface was first of all worked by means of an underlay shaft, marked No. 1 underlay shaft on the plan. As this went down it was found that the ore was in the form of a pipe-vein and dipping southerly, and when a depth of about 67 feet had been reached No. 2 underlay shaft was sunk to work it further. In this again it was found that the ore continued to pitch to the southward, and it was recognized that a main winding and engine shaft was required. This was accordingly sunk ("main shaft" on plan), and at 166 feet a crosscut was driven towards the lode. In this drive four veins were cut before reaching the main lode, all running more or less parallel to it. The first was met with about 16 feet from the shaft, and is known now as No. 3 lode. It dips 60° towards the shaft, and passes through it about 40 feet below this level. It is a small vein, and carries little (if any) tin ore where cut. At 21 feet from the shaft another small quartz vein, now known as No. 2 lode, carrying a little tin ore, was passed through. At 33 and 36 feet a pair of small veins were cut, and in the soft ground between them there was a little tin. These are marked *b* and *a* on the plan, and appear to be branches of the main lode. None of the veins above mentioned were of any magnitude, being practically only planes of division in the country rock coated with a little quartz, and often having the granite softened and decomposed along the sides of the

(No. 79.)

fissure. The soft ground between the veins *a* and *b* is rather altered country than true lode-stuff. The main lode was met with in the crosscut at 58 feet from the shaft, and was driven along till connection was made with the underlay shafts. The ore in the bottom of the No. 2 underlay shaft still pitching southward, was met with about 105 feet from the crosscut and followed up by a stope to where it left the side of the shaft. The lode is a mere fissure in the granite, rarely more than an inch wide, filled with quartz, clay, and fluorspar. The walls are smooth, and often distinctly striated, showing the vein to be a true fissure on which motion of the country rock has taken place. Though the vein proper is itself so small, the wall rock is often much decomposed, the felspar and mica of the granite being changed to kaolin and talcose material, and this soft rock often contains tin. For mining purposes it really is the lode, being the part from which the ore is extracted. The main shoot of ore from which all the tin taken from the mine has come is all altered wall-rock highly charged with tin ores. At the bottoms of the underlay shaft and the stope southward from it the lode is crossed by two veins (seen on the plan); which are probably those marked *a* and *b* seen in the crosscut. These dip steeper than the main vein at this part of the mine, and must drop into it before reaching No. 2 level, as they are not met with there. The shoot of ore coming down through the underlay shafts and stope continued again below No. 1 level, dropping nearly vertically to No. 2 level. The best ore in this part of it began at the point where a winze sunk on vein *a* proved it to fall into and join the main lode. The veins *a* and *b* seem to be branches of the main lode only, and probably join it again, going both north and south.

At 272 feet a second level has been opened, a crosscut being driven 27 feet to the lode, and then a level extended along it 163 feet. No. 2 lode was cut in the crosscut 15 feet from the shaft, but was a mere fissure, and so was not followed. It has been cut again in a small cross-drive from the drive along the main lode, showing that going northwards it is getting nearer to it, and rendering it very probable that both lodes will junction if followed to the north. In this level, as in the top one, the main lode was very small, being nothing but a mere fissure filled with quartz, clay, and fluorspar. The ore shoot between Nos. 1 and 2 levels is very large and fine, but will be described at length presently.

A third level has been opened at 336 feet. In this No. 2 lode was cut 6 feet from the shaft, consisting of from 6 to 12 inches of soft granitic matter and quartz, but with no tin, and the main lode at 27 feet from the shaft. Where first struck this was again merely a fissure plane between hard walls, but going northwards soft rock containing ore came in on the sides of the vein, and the available tinstuff opened out to two feet wide at 19 feet from the crosscut. At the time of my visit a winze was being sunk from the level above in the ore-shoot, and the drive was nearly up to the bottom of this winze. In the face the lode-channel had opened out to 10 or 12 inches, but there was also good tin in the soft granite of the hanging wall. The winze went down all the way in good ore, and I have since been informed that the drive was continued on for over 40 feet, all in good tin ground. At this level the lode certainly looks better and shows more tin than in the upper ones.

The shoot of ore has been the feature of this mine from the very first. Mr. Moyle, the manager at the time of my examination of the mine, was not in it at the time when the two underlay shafts were sunk, and could not give me much information about them, but between Nos. 1 and 2 levels the ground was worked out under his directions, and was examined by me in company with him. The ore body followed down through the underlay shafts and stope became small where passed through by No. 1 level, but made strong again some eight or ten feet lower, where the vein *a* dropped into the main lode. From this downwards nearly to No. 2 level there was a splendid mass of ore which has been taken out, leaving a great cavity over 30 feet deep, about 30 feet long, and from 10 to 17 feet in width. The fissure vein in the upper part of this was wider than usual, being from 2 to 3 inches wide, and consists mostly of green and purple fluorspar and some quartz. Very fine specimens of fluorspar are here obtainable. The tinstuff itself is granite wall-rock softened and altered and impregnated with tin oxide. The granitic matter is talcose and contains much kaolinised felspar. At one part of the south end of the shoot it contained a great deal of black tourmaline in radiated spherical bundles, and where these came in the tin went out. In some places the soft tin-bearing granite was separated from the hard country by joints or walls, but in others no line of demarcation could be drawn, the ore-bearing rock gradually merging into barren stuff. About 30 feet above No. 2 level the shoot became narrow again, and was small where driven through, but the winze sunk to No. 3 level was in good ore all the time, and according to report it would seem that the shoot has widened out at the bottom level so as to be longer than it has ever been seen in the mine before. It is most probable that the origin of the shoot is as follows:—After the fracture of the country which formed the lode channel, the solutions carrying the tin found their way more easily along certain comparatively open parts of the fissure than along such as had been almost entirely closed by the falling together of the severed walls. These solutions caused decomposition of the granite and deposited the tin in this altered and softened rock. The shoot would then represent the course of the main flow of water through the lode fissure. The thick vein of fluorspar (thick as compared with the usual width of the vein proper) must have been deposited in an open fissure, and this wide part of the fissure would naturally be the main channel for the circulation of the water carrying the mineralising solutions.

The mode of occurrence of tin ore in the Great Republic Mine is very similar to one described by Mr. J. A. Phillips in his treatise on Ore Deposits, as will be seen from the following quotation and the copies of his figures annexed:—

“An impregnation of granite by tinstone which occurs at East Huel Lovell, in the Parish of Wendron, Cornwall, has been very clearly described by Mr. C. Le Neve Foster. Figure 40 represents a horizontal section of this deposit as seen at the 100-fathom level, in which *a b* is the *leader* or *divider*, a small vein composed of quartz and ferruginous clay, varying from  $\frac{1}{4}$  to  $\frac{1}{2}$  inch in thickness. The dotted portion is the tinstuff, outside which is the ordinary granite of the district. This granite is well marked and encloses large crystals of orthoclase, while the stanniferous portion consists of a mixture of quartz, mica, gilbertite, and cassiterite, with a little fluorspar, iron pyrites, copper pyrites, erubescite, copper glance, and chalybitis. Gilbertite, a crystalline alteration product of felspar, is frequently abundant. There is no wall or selvaige between the tin-bearing mass and the surrounding granite, the two gradually merging in to one another, and, following the leader along its strike, the tin-bearing rock decreases in width until at last both walls of the vein are composed entirely of granite. The shoot of tin at the 100-fathom level was about seven

fathoms in length, the richest part having a length of three fathoms and a width of nearly nine feet. In some cases the oxide of tin lay entirely on one wall, as shown in figure 41, but the prevailing characteristics, namely, the leader of quartz, the absence of any wall between the tin and the granite, and the general composition of the tin ground, always remained the same. The main shoot of tin ore at East Huel Lovell has been followed from the 40-fathom level down to the 110 as one continuous pipe, and is in the shape of a long irregular cylindroid with an elliptic base generally about fourteen feet long by seven wide."

The ore in the Great Republic shoot has proved very rich, and if obtainable in larger quantity would make the mine a very profitable one. The ore is, however, unfortunately confined to this one shoot, as far as yet ascertained, the lode being outside of this too small and poor to be worked. As the shoot, though a strong and remarkable one, is of very small length horizontally, it has been necessary to do a great deal of dead-work for opening up a comparatively small piece of ground. Every successive level requires the main shaft to be sunk deeper, and crosscuts and drives to be made for a very considerable distance before the ore is reached. This large amount of dead-work is a severe burden on the mine, and unless other shoots are discovered, or the present one enlarges in depth, will probably lead to its eventual abandonment, even though good ore should continue to be found. That other shoots will be found by driving on the course of the lode is most probable, and exploration work to discover them should certainly be pushed forward. As there appears to be a tendency for the veins to come together towards the north, prospecting in this direction by extending the drives along the lodes is highly advisable. To the southward of the present workings it is not unlikely that the veins *a* and *b* will rejoin the main lode, and the junction may perhaps again form an ore-shoot. Should two or three more ore bodies similar to the one in the present workings be found, the mine would have a very promising future, but as long as all work is confined to the one shoot now in hand it can hardly be expected that much profit can result. The extension of this shoot in length at the No. 3 level is a favourable feature, and may be the beginning of a change for the better in the character of the lode generally. There is always a large amount of likelihood that a fissure vein, which is very narrow where first cut, will expand when worked on both in strike and dip, and as the regularity of the lodes in this mine, and the smoothed and striated appearance of the walls, point to their being strong lines of fissure, it is probable that wider portions will be found if looked for. It is not unlikely that both No. 1 and No. 2 lodes are branches from one lode, into which they will unite in depth.

Taking the proved richness of the known ore-shoot into account, as well as the probabilities of other shoots being found and of the veins coming together, and of the lode itself making wider when sunk and driven on, it is my opinion that this mine is a very genuine mining venture, and likely to prove a successful one. In its present position, however, it should not attempt to pay dividends out of any surplus realised from the good ore. So much has yet to be done to open up the mine, that if the ore pays for the dead-work the owners should be well satisfied for the present, and trust to get their profit from future developments.

The value of the ore in the shoot, which, it must be remembered, is the only part of the lode furnishing crushing-stuff, may be seen from the following figures:—

Between 11th December, 1890, and 1st December, 1891, 912 tons of ore were stamped for a return of 63 tons 18 cwt. of black tin, or 7 per cent.

In January and February, 1892, 90 tons of ore were crushed for 175 bags, or about 9 tons, of black tin, equal to 10 per cent.

Since the commencement of operations the product from the mine has amounted to 131½ tons of black tin, for which in all about 1560 tons of ore have been crushed, the average yield therefore being about 8·4 per cent. of black tin, or very nearly 6 per cent. of metallic tin, the yield of the black tin averaging from 70 to 72 per cent. of metallic tin. The value of this is about £8420.

As showing how much dead-work has to be done in proportion to the ore won, it may be stated that during 1891 out of an average of 26 men employed only 4 were at work getting ore.

The mine has a 10-head stamp battery for crushing the stone, and two Frue vanners for concentrating it. The gratings have 82 holes to the square inch, and the battery crushes about 30 tons of ore a week, working eight hours daily, or at the rate of 1½ tons per head in 24 hours. The crushed material does not go directly on to the vanners, but first passes through three straight narrow buddles, each about 10 feet long, in which the heaviest ore is saved. This is dressed by hand by washing in another straight buddle or tie, the tailings from which go on to the Frue vanners together with the overflow from the first three buddles. This arrangement, by taking out a large portion of the heaviest tin ore, lightens the work of the two vanners, which would otherwise be overburdened if set to treat the stuff from 10 heads of stamps, containing 7 to 10 per cent. of concentrates. The vanners are driven by a belt from the cam shaft, a bad arrangement that ought to be altered, as the tables cannot be driven with the required regularity from the cam shaft. No assays are made of the tailings, a defect that ought also to be remedied, as it is most important to control the working of the dressing machinery by regularly testing the tailings to see that an abnormal per-centage is not being lost. The battery is driven by a 20 h.p. portable high-pressure double-expansion engine, by Marshall. A sister engine is used for winding. The battery and dressing appliances cannot be said to represent a good type of dressing machinery, but under the circumstances of the mine are probably as good or better than a more elaborate plant. More room is badly required in the battery, working being very much cramped, but it serves very well to test the mine. Should the Great Republic become a large concern, a better style of dressing machinery and a larger plant would require to be erected. Classification of the crushed material, the first requisite for successful concentration, is at present ignored altogether.

*Ben Lomond Mine.*—No work is being done now on this property, and the expensive mining and ore-dressing plant erected is suffering much from disuse, woodwork being rotted, split, and warped, and iron-work eaten with rust. I was unable to examine the underground workings owing to the shafts being full of water, and the long adit partly fallen in and half-full of water also. It is not possible, therefore, for me to say very much about the prospects of the property. Some four or more lodes are known to exist in it. No. 1 is near the main shaft, which has been sunk to work it to a depth of 100 feet. The lode strikes N. 37° W., has an easterly dip, and is said to have averaged about 3½ feet in thickness. About 1½ chains N.W. from the main shaft a small shaft has been sunk on the lode to a depth of 80 feet, and about 50 feet

(No. 79.)

N.W. from this there is another 80-foot shaft. These two shafts are in my opinion unnecessarily close to each other, the exploration work done by the second being more easily and cheaply done by driving from the first one. The lode-stuff lying about these shafts is a rather hard, talcose, quartz, micaceous in parts, also white quartz with pyrites. Fluorspar is pretty common, and some tourmaline also is found. Not much tin ore is visible, but presumably any good stone extracted has been sent to the battery.

No. 2 lode lies to the west of No. 1, and strikes N. 22° W., dipping easterly. On this there is a surface excavation, 40 feet long, 15 feet wide, and 12 feet deep, from which I was told that 38 tons of tin ore had been extracted. In the bottom of the cutting the lode appears as a small vein of quartz and quartzose granitic matter, showing little or no tin, and enclosed in hard country. The rich pocket was in soft granite, and when the hard country came in the ore died out. The vein is very well defined in the bottom of the excavation, and from its former richness ought to be worth sinking on in the hope of finding other similar rich bunches. The ore-bearing stuff is now of course all gone, but from the description of it given to me it seems very probable that it was softened and altered granite impregnated with cassiterite, similar to what is found in the ore-shoot of the Great Republic mine, and the experience of this would lead us to expect it to be found to continue downwards. Practically no search has been made for it below where the ore cut out, a winze sunk a few feet on the vein being hardly worth mentioning. It very often happens in ore-shoots that there are blank spaces beneath which the good ore again makes.

A few feet westward of the excavation are some thin quartz veins, striking N. 22° W.

Between the lines of No. 1 and No. 2 lodes, and about 1½ chains from the line of No. 2, is a lode carrying a great deal of tourmaline, striking N. 25° W., and dipping vertically, or with perhaps a very slight underlay to the westward. The vein where cut shows 12 inches of almost solid tourmaline rock, with the tourmaline in interlacing radiating needles, and 12 inches of quartz mottled with bunches of tourmaline.

No. 3 lode is about 1½ chains west of No. 2, and is cut in a drainage race from the excavation at No. 2. It consists mostly of felspathic matter, with some tourmaline.

No. 4 lode is perhaps one chain further west, and consists of micaceous quartz carrying a little visible tin ore.

Westward again from this is a lode of iron pyrites and quartz about two feet thick, running N. 25° W., and dipping easterly at a high angle.

It will thus be seen that a series of parallel veins have been cut on surface, and to cut them underground an adit about 750 feet long has been driven on a course N. 57° E. A fall of the roof had dammed the water back in this, and prevented me from going into it more than about 100 feet. The adit is some 105 feet below the outcrop of No. 1 lode. As far as I could learn, very little driving has been done on the lodes either from the shafts or from the adit. I could not ascertain how much stone has been crushed, but was given to understand that the quantity was quite small, the surface excavation on No. 2 lode furnishing the greater part of it.

At the mouth of the adit a 10-head battery has been erected, furnished with classifiers, jiggers, and ties as tin-saving appliances. The whole building is now in very bad order, the woodwork being very much warped and shrunk, so much so that the dressing appliances would have to be entirely renewed before doing any work. They could not have been very efficient in the first instance, for, though fairly good so far as they went, there seems to have been no adequate provision for the treatment of the fine sands and slimes.

X This mine is a standing example of a mistake which is far too common, and which ruins many promising ventures. The capital of the company has been spent on building a battery and doing dead-work of one sort and another before proving the mine itself. If I have been correctly informed, the main shaft was sunk before the adit was driven, and it would have been an easy matter to prospect Nos. 1 and 2 lodes from the shaft to the same depth as is commanded by the adit. It would have been better to do this prospecting work from the shaft before driving the adit. If it had proved satisfactory the construction of the tunnel would have been very desirable, as it cuts through the whole system of veins, provides a way to the battery, and drains the mine to a depth of over 100 feet. If the adit had been made before the main shaft was sunk and provided with winding engine and pumps, the mine would have been proved to the same depth as now without any necessity for these. Hence, so far as testing the mine to a depth of 100 feet is concerned, either the main shaft and its machinery or the adit is altogether superfluous. Had the mine proved a good one both would have been doubtless required, the shaft to work the ground below the adit level. But all the available money was spent in building the battery, erecting winding and pumping machinery, sinking shafts, and driving the main tunnel, and at the end of all this nothing was left to look for the tin with. Had the money used for the battery and driving the adit been expended in driving on the lodes from the main shaft a great deal of exploratory work could have been done, and it is very probable that the mine would have been in operation to this day. The lodes are strong and well defined on surface; some of them have been in parts very rich in tin, and there is very reasonable hope that payable shoots of ore would be found in them if they were explored. The amount of work done underground is so small that their value cannot be at all regarded as disproved, and it is likely enough that it may yet be a very profitable investment. As the lodes can now be driven on from the adit at small expense, it seems to me that prospecting them would be a very legitimate risk. The experience of the Great Republic mine in finding the ore concentrated in rich shoots is very likely to be repeated in this and other mines throughout the district, especially as there is reason to believe, from the parallelism of the Ben Lomond, Great Republic, and Gipps' Creek lodes, and from their similarity in easterly dip and mineral contents, that they all belong to one system of contemporaneous fissures, and are therefore likely, according to the experience of mining districts all the world over, to have many features in common and be very similar in their behaviour.

In the approach cutting to the Ben Lomond Company's adit shales belonging to the coal measure series of rocks are exposed, and the section is of peculiar interest as showing features that lead to a suspicion that the granite itself has been intruded into the sedimentary strata. As this point has considerable geological importance, a sketch section of the occurrence is attached. On the south side of the approach, just at the mouth of the adit, the granite, *a*, which is of the usual type common throughout the whole district, contains imbedded in it rounded pebbles of quartz and quartzite. Immediately above the

granite the shale is very much broken and displaced, and contains similar pebbles to those enclosed in the granite. The surface of the latter at the contact is full of broken shale and rounded pebbles. It is also clear from the section that either the portion *c* of the shale has been faulted down between the masses of granite *a* and *d*, or that the latter have been pushed up through the shales. The shale above *d* is a little broken, though not so much as over *a*. In the shale, the beds of which lie very flat, I found carbonaceous markings but no distinct fossils, and a good many pebbles of quartz and quartzite. Though the surface of the granite is much decomposed and softened, it seems hardly possible that pebbles could have been actually sunk into it for a distance of two or three feet, and the explanation that seems to fit the case best is that the granite masses were intrusive, and in pushing their way up through the shales absorbed portions of the latter, but could not absorb the pebbles of nearly pure silica contained in them. Against this theory has to be placed the fact of the crystals of quartz and felspar in the granite being as large and well defined at the contact with the shales as anywhere else, and that the shales, though broken at the contact, are not hardened and metamorphosed, as they would probably have been by a plutonic intrusion. The presence of fragments of granite in some of the mudstones of the permo-carboniferous series proves conclusively that some at least of the granite was in existence as a hardened rock before the shales were laid down; for, from their lithological character, the carbonaceous workings found in them, and their horizontal bedding, there can be little question of the latter belonging to the permo-carboniferous formation. Until further evidence is available a satisfactory explanation of the section will probably be wanting.

*Gipps' Creek.*—An interesting system of lodes is seen in the valley of Gipps' Creek in a small branch stream running through Sections 3116-87M (R. Bennell), 3118-87M (Gaunt), and 2650-87M (Gaunt and Foster), and also in Sections 2338-97M, 2309-87M and 2308-87M (all in the name of A. Mayne), known as the Long Tunnel Company's Property. Near the junction of the branch creek with the main one in 2650 87M, a good deal of ground sluicing has been done and very fair tin obtained. A number of fairly parallel veins bearing between N. and S. and N.W. and S.E. have been exposed in the bed rock by this work, all dipping easterly. They consist of quartz with a great deal of tourmaline and some wolfram, and occasionally tin ore. Splendid specimens of tin ore in quartz, but little waterworn, have been found in sluicing, and pretty plentifully, but no lode of corresponding richness has yet been struck. As the veins are seen in parts to contain tin it may be that the rich specimens are from patches in these, but I think it is more likely that they are derived from lodes higher up the little creek. A few chains above the alluvial workings a trench has been sunk on a lode of quartz and tourmaline running north-westerly. A few stones of white quartz containing wolfram were lying about the hole, but I saw no wolfram in the lode, which is hereabout 4½ feet in thickness but not well exposed. About half a chain north-west from this a number of narrow veins of quartz running close to and parallel to each other and bearing N. 20° W. have been laid bare, dipping about 45° to the eastward. The quartz is highly charged with tourmaline, but I also got some specimens with nice tin ore in them as well. These veins are probably part of the 4½ foot lode or else are parallel and close to it. A short tunnel across them into the hill at this point would give valuable information. The tourmaline in these veins is very similar in occurrence to that in the tourmaline lode in the Ben Lomond property previously mentioned.

The sluicing work shows that the small creek is running almost upon the bed rock and for prospecting purposes it would be very easy to carry a trench right up to its bed across the line of the whole lode system. In winter when water is plentiful this work could be very cheaply done by its aid: any lodes crossing the creek would then be laid bare. The specimens obtained in sluicing are so tempting that more work should certainly be done to try and find the lode from which they have come, and as it is clear that there are a number of parallel veins running across the creek there is no easier way of prospecting them than by stripping its bed right up. Should valuable lodes be found the ground is sufficiently steep to allow of their being well tested by means of adits without winding and drainage expenses. The owners cannot be congratulated on their enterprise in working those promising sections, which have been held for four or five years and practically nothing done on them.

In the *Long Tunnel* mine work was at a standstill at the time of my visit, and had been so for a long time. A good deal of mining work has been done, and at least three distinct lodes have been cut. From their position and course these probably belong to the same system of veins as those described in Gaunt, Bennell, and Foster's Sections. On the north boundary of Section 2358-87M an underlay shaft has been sunk on a lode 2 feet 3 inches thick, striking N. 10° W. and dipping easterly 50°. This is a very well defined lode with distinct walls. The veinstuff is mostly quartz, somewhat granular, and containing hydromicas and talc, and shows a somewhat banded structure in parts. A very fair amount of tin ore is visible in it, and in the stuff extracted and lying at surface the tin seems to be in payable quantity. A vein of copper pyrites about two inches thick with rich tin ore in close proximity is seen in the sides of the shaft. This, after following the lode down for some 20 or 30 feet on the underlay, was sunk vertically through the footwall to connect with a tunnel that has been driven for the purpose of cutting the lode. This tunnel, however, before reaching the tin lode, struck another one composed of barren quartz, which was driven along presumably in the belief that it was the lode sought for, until it was proved to be a different one by the sinking of the aforesaid vertical winze from the underlay shaft. This quartz lode runs N. 10° W. and dips easterly about 1 in 1, and must therefore be almost exactly parallel to the tin-bearing one both in strike and dip. The tunnel would probably have to be extended some 50 feet past the quartz lode before striking the one seen in the shaft. Another shaft has been sunk on the tin lode to the south of the line of the tunnel, but being full of water could not be examined. The material thrown out of it shows a very fair quantity of tin ore. This lode seems well worth giving a practical trial, and by extending the adit to cut it this could easily be done.

In the south part of Section 2358 a long tunnel, from which the mine takes its name, has been driven from the side of Gipps' Creek to a total distance of 560 feet. The roof having fallen in at about 300 feet from the mouth, I could not examine more than half of it. The first 200 feet are through country rock, on a course N. 10° W., then it veers round to about N. 12° E. for about 80 feet, when a small lode running N. 10° W. and dipping easterly 50° to 60° was met with, and the drive continued northwards along its

course. This is probably a parallel lode to the one cut in the north of the section. As the adit is driven exactly on the course of the system of lodes, it has nothing like the same prospecting value as a crosscut would have had. It would have been far better after driving into solid and settled country to have driven crosscuts east and west across the strike of the lodes, and then driven on these as they were picked up. The lode found at about 280 feet from the entrance was probably never more than from 30 to 40 feet to the east of the tunnel all the way, and it was only through changing the course that it was struck. I certainly think that crosscuts should be driven from this tunnel if value is to be expected from the expense of making it.

Near the western boundary of Section 2358-87M a lode has been struck in two or three trenches and a shaft (now fallen in). Some pretty good tin is seen in the stone. The vein is said to have been from 18 inches to 3 feet wide in the shaft. Course N. 10° W., dip easterly. An adit has been commenced to cut this lode, but was discontinued after going 75 feet without reaching it. As this adit, if continued, would have cut all the lodes pretty well at right angles, it is a pity that it was not driven instead of the long adit. Both are on much the same level.

It will be seen from the above account that a great deal of work has been done without result. Of the three tunnels driven, aggregating about 1000 feet in length, none have reached the lodes proved on surface to contain tin. Both the tin-bearing lodes are well worth trial, and could be easily tested without much further expense. Their easterly dip is rather troublesome, as it makes the adits required to reach them much longer than if they had been vertical or dipping westward. The non-success of the former company should not be allowed to prejudice this mine in public estimation, for the prospects are neither better nor worse than before they started operations, all their trouble and expense having done nothing to prove the lodes, though they have made it easier for some one else to step in now and do so.

The Long Tunnel adit is about 400 feet below the plateau, on the western edge of which the Great Republic and Ben Lomond mines are situated. It would therefore be possible to do a very large amount of prospecting by driving eastward at right angles to the average course of the lodes. At least two groups of lodes are known to exist between Gipps' Creek and the eastern boundary of the Great Republic Company's ground,—viz., those of the Long Tunnel Company's and Bennell, Gaunt, and Foster's sections, and those of the Ben Lomond and Great Republic Companies' ground. Between these two groups there may be, and very likely are, others parallel to them. The strong lode of the Rix's Hill mine further south shows that the north-north-westerly to northerly system of veins is persistent over a long distance in strike. It is therefore possible that if a real "long tunnel," say 8000 feet long, were driven in from Gipps' Creek a large number of lodes would be cut by it at depths up to 400 feet. By coming lower down the creek to a point west of Section 1651-87M an adit could be got from 700 to 750 feet below the plateau. This would probably, however, begin too far to the east to cut the Long Tunnel Company's group of lodes. Water-power for driving machinery for compressing air and haulage could be easily and cheaply obtained from Gipps' Creek. In the present undeveloped state of all the mines it would be premature to undertake any such extensive scheme of work as this, but should the district turn out well it would be practicable, and indeed necessary. It is not at all outside the domain of practical mining to contemplate the possibility of driving right through to Story's Creek, a distance at the most of five and a half miles. At their nearest points the streams are only four miles from each other.

*Story's Creek.*—A large number of sections have been at one time taken up near the head of Story's Creek, but at present next to no work is going on, and many of the leases have been forfeited. On the Story's Creek Tin Mining Company's property (Sections 2141-87M, 1089, and 1077, held in the names of J. C. Genders and R. Bennell), one, and sometimes two, men are kept employed. Far more work has been done on this Company's ground than on any of the adjacent holdings, and it will be alone described now. The country is different from that in which the previously described tin lodes are situated, being in highly inclined metamorphic sandstones of probably Silurian age instead of in granite. The latter, however, is not far distant, being found in Nesbitt's Creek on the west, and on the east on the ridge between Story's Creek and the head of the Aberfoyle Rivulet, and probably the Silurian formation is also underlaid by it at no great depth.

A great deal of surface-work has been done on these Sections, the soil, though very shallow, having often contained large quantities of tin ore. So good are the prospects of loose tin that there seems at first sight every reason for the high estimation that has been held of this property by the owners and many others who have visited it. It is very reasonable to believe that where there is so much loose tin on surface, evidently from its angular and little abraded nature not carried far from the parent veins, there are good lodes beneath, and this belief, though not yet borne out by the results of the underground work performed, can by no means be regarded as overthrown, as it may well be that the rich veins have not yet been discovered. An examination of the numerous veins laid bare, however, is apt to modify the good opinion formed by looking at the loose tin alone, as it shows that there are numbers of quartz veins, mostly too small for profitable working, carrying bunches of very rich ore. The wearing away of these under atmospheric influences would have the effect of releasing large quantities of tin ore, and it might well turn out that, instead of there being one or more good lodes in the country that have supplied the tin, there are a large number of small and poor ones, unpayable as a rule, but bearing rich little pockets of ore. Going over the veins that have been exposed it would be very easy to pick out large numbers of most excellent specimens, but to take the general lodestuff as it comes to hand, it would not be payable. The tin ore is generally in large coarse crystals or aggregations of crystals, forming bunches in hard white quartz. Many miners look upon such occurrences with disfavour, regarding stone with the tin ore finely impregnated through it as much more permanent, while the coarsely crystalline ore in rich patches is considered likely to exist in only small quantity.

Without making a regular survey, it is hard to say how many separate lodes are exposed in this property. The surface-workings are on flattish ground, forming part of the terrace which extends to Gipps' Creek, though cut off from the main part of it by the valley of Nesbitt's Creek, a small tributary of Story's Creek. The underground workings are from the deep gully of the latter creek, and I am not certain as to the connection of the three or four lodes seen there with those exposed on the flat ground higher up. Where there are so many similar lodes or veins, careful tracing and pretty accurate surveying

would be required to establish the identity of a lode seen in two or more places at considerable distances from each other. In the northern portion of the surface-workings several leaders of white quartz from 3 inches to 6 or 8 inches wide are seen, all running between N. 30° W. and N. 40° W., and dipping westerly about one in one. These appear to belong to a system of parallel veins lying close together rather than to definite lodes. They often contain rich patches of coarsely crystalline tin ore, especially on the edges of the quartz veins: wolfram is also very frequently seen. The quartz, as a rule, adheres fast to the metamorphic sandstone or slate country, and is not divided from it by a flucan or selvage. These veins have very nearly the same strike as the beds of the country rock, but appear to cross them in dip. About two chains to the east of these veins, on the brow of the slope leading down to Story's Creek, an open cutting has been made into a place where several veins of quartz have been cut close together. The main vein runs about N. 50° W., and dips westerly 60°: it is about 12 inches thick, and contains a good deal of wolfram. Several flat-lying veins, dipping westerly about 30°, and from 8 to 12 inches thick, are seen making into the main vein: some of them carry patches of tin ore, much of it resin-coloured, and generally adhering to the outside of the quartz veins.

Going a short distance to the south of this cutting along the brow of the gully an undeveloped quartz lode running north and south is met with, and following it southward two others parallel or nearly so to it are also seen, all three lying close together. The north-westerly and northerly veins must form a sort of network in some portions of this ground. The quartz veins are all similar to those above described, hard white quartz with occasional bunches of coarse tin ore. Belonging to the north and south series of veins mention must now, however, be made of another occurrence which is of a more promising character, found towards the south end of the surface workings. This is a very flat-lying vein of soft clayey matter, much stained and mixed with oxide of iron, and containing a good deal of tin ore, being in streaks very rich. The strike as far as now ascertainable is N. 5° E., dip westerly about 15°. From quite a small hole sunk on the outcrop 16½ bags of tin ore were obtained by sluicing the soft lode-stuff, the tin ore being crystalline, and not in any way waterworn. About a chain to the south of this, where the flat vein appears to junction with one or more of the other lodes, another small hole yielded 10 bags of tin. (A bag of tin ore weighs about one hundredweight). This occurrence being all in the somewhat broken surface rock, and not in solid settled country, is not quite clear as to its nature, but it is probably a very flat lode, two or three feet thick. The amount of tin seen in it makes it well worth further prospecting, especially as its character is more favourable for tin than the hard quartz lodes. I regard this as the most promising feature of the property, and one that ought certainly to be worked on so that more definite knowledge of it may be obtained.

The underground workings consist of levels driven from the valley of Story's Creek about 100 feet above the level of the stream. The main level is driven along the course of a lode of white quartz, 2 to 4 feet in thickness, carrying a few patches of tin ore and a good deal of wolfram. It has well-marked walls with clayey selvages, and varies in strike from N. 17° W. to N. 32° W., dipping westerly about one in one. The level has been driven some 300 feet along the lode, the latter being a good deal split up in the face where work has been left off. About 120 feet from the mouth of the tunnel a crosscut has been put in to the eastward, and at about 60 feet another lode of quartz is cut, after passing through which the crosscut has been extended to about 300 feet without further discoveries being made. This second lode is from one to two feet wide, strike N. 17° W. to N. 20° W., and dips westerly 35°. It has been driven on to the northward, and one or two stopes have been taken out on it. The walls are well defined, the quartz being separated from the country by a clayey selvage. A little tin and a good deal of wolfram are visible in the stone. At the mouth of the tunnel about 15 feet west of the main lode another small parallel quartz lode has been cut, but not further worked on. Throughout these workings the quartz is hard and white, and the tin ore when it does occur is concentrated into coarsely crystalline bunches. The wolfram is also in patches, and a great deal more abundant than the tin ore. As far as can now be seen the lode-stuff extracted must have been very poor.

The same mistake made by the Ben Lomond Company has been repeated here, a battery having been put up before the ore was in sight to keep it going. It has been well built, but is now falling into serious disrepair. There are ten stamps, a pair of spitzbitten, one 3-sieve jigger, one shaking-table, and several ties. The motive power is derived from a 32 ft. overshot water-wheel, the water for which is brought down by a pipe from a race which comes over the terrace, and is supplied from a dam higher up Story's Creek. A turbine or Pelton water-wheel, under the circumstances, would have been a much more efficient motor, as well as cheaper and simpler. The ore from the tunnels can be run directly on to the feeding-floor of the battery, and this being built on the slope of the hill very little handling of material is required. The mill being well placed for working the ore from the present levels, it is perhaps rather unfair to criticise its location, but it may be pointed out that a lower adit could be put in to cut the lodes from the level of Story's Creek 50 or 60 feet below the battery, and if the mine went ahead this would have to be made. The mill would then have to be moved, or the ore lifted to it. It seems to me that it would have been better to have put the dressing-floors lower down the creek; the stone from the present levels could then have been sent down to it by a shoot, the ground being steep enough for this to work well, and at the same time the ore from the low-level adit could have been brought along a level grade. Probably quite 60 or 70 feet more head or pressure could then have been obtained from the race to work a water-wheel or turbine, with consequent large increase of motive power.

Leaving out of consideration the further prospecting of the soft flat lode above-mentioned, which ought to be done in any case, and dealing only with the quartz veins, it seems to me that before giving them up as hopeless it would be worth while ascertaining if they passed into the granite country at a reasonably accessible depth. The granite may be regarded as the source of the tin in the overlying Silurian formation, and should the lodes, as is likely, pass down into it at no great depth, there is a very considerable probability of their being much richer in the more favourable country. A large quantity of tin, taking it altogether, certainly exists in the upper parts of the lodes, but so much scattered as not to be payable, and, as this is almost certainly derived from the lower granite, the presumption that the lodes will improve going downwards has a good deal in its favour. It would be interesting to find out if any of these lodes can be traced into the granite along their strike, and if any dislocation takes place at the contact of this and the Silurian formation. The lodes dipping westward at a flat angle towards the granite which appears in

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Nesbitt's Creek only a short distance to the westward, it is possible that valuable knowledge could be gained by boring with a diamond drill at a point where the lodes might be expected to be struck at a depth of 600 or 700 feet, there being a likelihood of their then having passed into the granite.

*Tasmanian Tin Mining Company.*—In going to Story's Creek from Avoca we pass through the sections formerly held by this company and a number of others. The ground has been abandoned for years, and the scrub is beginning to cover the old trenches and workings. The Tasmanian Company had a main shaft, winding and pumping machinery, and a tin-dressing plant, but after a very little underground work the flat tin-bearing vein which had been the basis of expectations failed, and the mine stopped. The machinery was sold off, and much of it is now lying rusting on the hill above the Story's Creek battery. A great many old trenches and small shafts are to be seen all over this ground, but from the stone visible now the prospects do not seem to have been very good. In a trench about six chains north-east of the old main shaft a lode formation is seen, three or four feet wide, striking N. 57° E., and carrying a little tin with a good deal of tourmaline. The lode-stuff is talcose soft granitic matter, some of it hardened by infiltration of silica, with a little clean quartz. I have been informed that very good prospects of tin can be obtained on parts of Egan's Freehold, Lot 882, but as this is private property no mining can be done. The granite country in all this neighbourhood is favourable for the occurrence of tin lodes, and this part of the district may come to the front again at any time with new discoveries.

*Summary.*—To sum up as to lode-mining in the Ben Lomond District it must be first of all said that the amount of development done is not at all commensurate with the large amount of money that has been spent on the mines. With the exception of the Great Republic and Story's Creek mines hardly any work has been done on the lodes; there has been a great deal of fossicking about and scratching the surface, a great deal of work begun and not finished, much premature erection of machinery, great expense in all sorts of ways, and consequently the investing public have lost faith in a field which absorbed so much money without yielding results. Nevertheless there are numbers of genuinely good opportunities in the district for legitimate mining work, and if this is carried on in a well directed and economical manner, having regard only to getting returns out of the ground and not out of the share-market, I have little doubt that in course of time there will be steady and productive mines opened up. It cannot be gainsaid that this field stands very ill in the public estimation at present, but it has been condemned without a fair trial, mainly on account of useless and extravagant expenditure on everything except the lodes themselves.

*Alluvial Tin Deposits.*—Throughout the Ben Lomond District there has been but little alluvial tin obtained. Such gravel drifts as have been found are of comparatively small extent and shallow, and are confined to the valleys of the existing watercourses. Those of Gipps' Creek have been the most important. As this absence of alluvial tin is often regarded as an indication of poverty of the lodes beneath, it is of consequence to point out that there are reasons for it, both geological and topographical. On the terrace where gravels are often expected to be found the patches of the coal-measure formation abundantly seen widely spread all over it show that till quite recently the granite, the matrix of the tin, was covered by younger non-stanniferous deposits, and has not been subjected to any appreciable amount of aqueous erosion, which alone could set free and concentrate its contained tin ore. The only places where there has been any considerable erosion of the granite are in the deep gullies of the creeks running down from the terrace. Even in these, in the Castle Carey and Gipps' Creeks more particularly, there is proof that great portions of the valleys have been scooped out of the permo-carboniferous strata before reaching the granite, so that the amount of this that has been sluiced by the operations of nature is smaller than might be at first thought. But the principal reason of these creeks not carrying more tin is the steepness of their beds, on account of which the ore has no doubt been swept down into the South Esk Valley, and should be looked for in the deep flat ground where the streams debouch into it. A certain small amount of tin is found in all the creeks, and in Gipps' Creek, where, through the bed being in places flatter than is usual, accumulations of gravel have been deposited at more than one part of the valley, the workings have assumed considerable importance.

*Clunes Workings.*—To the west of the Long Tunnel Company's ground, on Sections 2267-87M. and 2265-87M., a considerable amount of alluvial tin has been obtained from a branch creek running into Gipps' Creek. The ground is not deep, rarely more than 4 and 5 feet, and though understood to have been highly payable at first is now believed to be practically worked out. The richness of this gravel argues well for the value of the lodes known to exist along the eastern slope of the valley.

*Rigney's Freehold.*—About a mile and a half below the Clunes workings we come upon an alluvial flat of considerable extent, being about 35 chains in length along the creek and averaging perhaps six chains in width, an area of from 15 to 20 acres. The creek on which the Great Republic Company's battery is situated joins Gipps' Creek towards the head of this flat. A piece of land comprising this flat, and in all containing 107½ acres, has been leased from the owner, Mr. J. F. Rigney, by J. Powell and others, and is known as the Rigney's Freehold No. 1 Company's Block. About 30 chains lower down, and at and below the junction of the small creek that runs past the Ben Lomond Tin Mining Company's battery with Gipps' Creek, there is another smaller flat comprising about 10 acres in all, which is contained in a block of 124 acres leased by Mr. Rigney to Hudson and Murrell, and known as Rigney's Freehold No. 2. Still further down Gipps' Creek other similar flats are seen which will doubtless be worked if the above-mentioned two claims prove payable. The geological features of the valley are noteworthy and supply an explanation of the formation of the alluvial deposits. The eastern side is composed of steep slopes and cliffs of, in the upper part of Block No. 1, granite, and, in the lower part of No. 1 and the whole of No. 2, coal measures, sandstones, shales, and limestones. The western side appears at first sight to be all greenstone, but here and there we find traces of carboniferous shales showing under this rock, and in reality it would seem that the coating of greenstone on the slopes is only a superficial one. Further examination shows that the greenstone is all in loose blocks, and frequently the shape of the ground reveals that numerous landslips have taken place. The high ridge west of the creek seems to be composed of green-

# PARISH OF BENLOMOND

BEN LOMOND

Flat about 400 ft. above sea level.



RIVER NILE

FISHER'S SADDLE

BEN LOMOND RIVULET

Lot 788 187 ac  
J. B. Bomford

Lot 30 640 ac  
J. Batman

Lot 3680 ac  
H. R. Talkiner

Lot 3720 54 ac  
John Toal

Lot 380 640 ac  
Simeon Lord

Lot 59 4080 ac  
J. Rigney

Lot 2789 505.2 ac  
Simeon Lord

Lot 2790 500.0 ac  
Simeon Lord

Lot 2791 500.1 ac  
J. B. Bomford

Lot 76 440 ac  
Simeon Lord

640 ac  
Simeon Lord

1330 ac  
J. K. Gray

600 ac  
S. Rodd

103 ac  
J. Winch

800 ac  
J. K. Gray

5 cm

## MINERAL SECTIONS

### BEN LOMOND

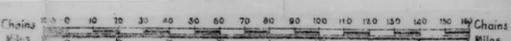
## COUNTY OF CORNWALL

OFFICE OF MINES JUNE 1892

*J. Montgomery*  
Supt. Surveyor

- GREENSTONE.
- GRANITE.
- SILURIAN.
- CARBONIFEROUS.
- TERTIARY.
- BASALT.

Scale



stone, and may be either a dyke or a flow which has run over the carboniferous rocks, and has no doubt supplied the blocks that now cover all the western slopes of the valley.

At a point in No. 1 Block west of the head of the alluvial flat, and at an elevation of 220 feet above it, alluvial gravel consisting of waterworn quartz, granite, and granitic lodes-stuff, and containing some fair prospects of tin ore, has been discovered on the slope of the hill. This appears to form a terrace some three or four chains in length, but had not been cut into at the time of my visit (27th May, 1892) sufficiently to show its width. The finding of river gravel at such an elevation above the present stream is very instructive, and opens up a large field for prospecting, for there may be many other such terraces along the slopes of the valley on both sides. The gravel must have been laid down when the stream ran at a much higher level and had not eroded its valley to anything like the present depth. As time went on it has cut its way lower and lower, and there is therefore a probability of finding other terraces left behind on the slopes of the valley at various elevations. At the lower end of the flat on No. 1 Block, on the western side of the valley and 40 feet above the flat, alluvial gravel left in this way has already been found. It contains some tin ore also. These two older deposits on the slopes of the valley are not likely to be the only terrace drifts left behind by the creek while cutting its way downward, and it will therefore be advisable to prospect both sides of the valley for others. The presence of tin ore in both terraces in appreciable quantities is also a strong argument for the existence of rich gravels in the present river flats, as much of the gravel of the older terraces must naturally from time to time have been washed down into the creek. In prospecting for terrace gravels regard must be given to the possibility of their being covered by superficial slips of greenstone from the higher parts of the ridge. So much of this appears to have gone on that there is a strong probability that most of the gravel deposits will be covered. The readiness with which the surface soil of these slopes slips is easily explainable when we consider that the valley has been in great measure eroded out of a mass of soft shales which readily become clayey on exposure to atmospheric influences. Rain-water descending through the porous surface stuff is stopped by the shales below and runs along their clayey surface, thus causing slips of the overlying material. The rather common occurrence of springs of water on the western slopes of the valley is due also to the drainage waters being unable to sink into the shales, but finding a passage between them and the surface stuff.

The formation of flats of alluvial gravel in the creek is now easily explained: from time to time large landslips have slid down into the valley and blocked the stream. In the dams so formed gravels have accumulated until the barrier has been cut through again by the running water. In the case of the two properties mentioned, it is probable that the present outlets from the flats are not yet so low as the original creek bed, as the gravel deposits appear to be deeper than them. The stream has been forced over to the eastern side of its valley by the slips and has cut down there to solid rock, which has then prevented it from scouring down to the old level. In both flats it has been found necessary to blast tail-races through the solid rock bars at the outlets in order to be able to work the drift behind them. In the No. 2 Company's tail-race the bar is fossiliferous limestone and calcareous shale belonging to the permo-carboniferous system, and very rich in organic remains. The bar at the outlet of the No. 1 Company's flat is a dark shale, divided by strong joints into polygonal prismatic blocks resembling basaltic columns when seen at a little distance. This polygonal vertical jointing is probably due to the presence in the near vicinity of a greenstone dyke, which has strongly heated the shales. The joints are clean-cut plane faces, and the blocks show sharp angles between adjacent faces.

In both flats a number of test pits have been sunk to prove the ground, with very encouraging results. This work was still in progress when I visited the claims. The holes are from 8 to 16 or 20 feet deep. One which was free from water when I saw it was 12 feet deep. There were 6 feet of black surface soil on the top; then 6 feet of heavy gravel, composed mostly of granitic debris, and containing more or less tin all through it; then limestone bottom, which had a slight pitch westerly away from the present stream. Mr. Macdonald, who was in charge of the work, informed me that this feature was very noticeable in most of the pits he sunk, indicating that the old original creek-bed lay to the westward, under the covering of slipped greenstone blocks which has driven the stream out of its old channel. As might be expected, considerable difficulty is experienced in sinking these pits on account of water, but enough has been done to show that there are large quantities of tin-bearing gravel, and that the deepest ground lies along the foot of the western slope of the valley, or even under it. I do not think, however, that as a rule there will be any large extent of gravel found buried under the slips, though the main gutter must in places be so covered. Between the two flats the gully in which the creek runs is narrow and with steep sides, but one or two holes have been sunk, and proved that there is gravel to a considerable depth below the bed of the stream, and that it carries tin. Wash is to be seen in one place in the side, covered with surface detritus. On the whole I am quite satisfied that this creek amply warrants a working trial, and that present appearances are all in favour of its being payable when worked by hydraulic sluicing. The wash might be treated by ground-sluicing without much trouble after deep tail-races had been blasted through the rocky bars at the outlets, but the advantages of the hydraulic method in cheapness and expedition are so great that there can be no question that it is the proper one to adopt. It might be advisable, in order to thoroughly test the ground before going to the expense of bringing high-pressure water on to it, to do a certain amount of ground-sluicing, but when the real work begins, hydraulicking must be resorted to. As an example of the cheapness of hydraulic work, I may quote the cost of it at the Blue Spur Company's claim in Otago as given in the Reports on the Mining Industries of New Zealand, 1891. Here the material is not only broken down and sluiced by the hydraulic method, but also elevated to an average height of 60 feet by means of hydraulic elevators. During the year ending 31st December, 1890, 410,000 cubic yards of stuff were elevated and sluiced, yielding only 1 3/4 grains of gold, or a value of 3 1/2 d. a yard. The expenditure on wages was only about 1 1/2 d. per yard. It will therefore be evident that under favourable circumstances tin drifts yielding only from a quarter to half a pound of tin ore to the cubic yard could be profitably dealt with by hydraulic sluicing.

The facilities for hydraulic work in the present case are unusually good. The outlet of the upper flat is about 300 feet below the Clunes workings and 750 feet below the Great Republic mine; the second flat is about 60 feet lower. Gipps' Creek affords a never-failing supply of water, and smaller supplies, but of greater head, can be obtained from the Great Republic and Ben Lomond Creeks. Only comparatively

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short pipe-lines would be required. Water can also be got during the winter from the top of the ridge on the western side of Gipps' Creek, and this supply will enable the terraces to be worked. Experience in hydraulic working has shown that money is well spent when used to secure possession of copious supplies of high-pressure water, and that it is false economy to be niggardly in the matter of races and pipes. Having a good high-pressure supply will also remove any difficulty that may be encountered in getting fall for tailings as the workings are advanced into the flats, and also will do away with the need for cutting deep tail-races at their outlets, for it may be utilised to raise the stuff by hydraulic elevators. In order that the debris from the upper workings shall not be deposited on the flats lower down the stream to the detriment of their working, it will be best to avoid sending the tailings down the creek as much as possible, and the employment of elevators to stack the tailings on the worked-out ground would on that account alone be highly beneficial. There can be no doubt that if these upper flats are payable several others lower down the creek will also be worth working, and the prevention of the tailings from going down on to them from the top workings is therefore a matter of great moment. Deposition of sludge is often a source of much litigation in creek workings of this sort, and everything possible should be done to avoid it. (Some notes on hydraulic elevators were attached to my Report of last year on the Gladstone District, published with the Report of the Secretary of Mines for 1890-91).

I have not examined Gipps' Creek below its junction with the Buffalo Creek, but if there is payable tin in the upper parts there is a likelihood of there being a good deal also in favourable situations right down its course. The workings of the two companies that have been formed will therefore be of much general interest, as they will very probably be the means of opening up a considerable sluicing industry.

I have, &c.

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

*The Secretary of Mines, Hobart.*

