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NOTES ON THE QUEEN RIVER AND MOUNT LYELL MINING DISTRICTS.

Geological Surveyor's Office, Launceston, 9th July, 1894.

SIR,

DURING the months of May and June I made two visits to the alleged new gold discovery at Mount Huxley, reports on which have been forwarded to you, and while in the district took the opportunity of visiting a few of the mines in the Queen River and Mount Lyell fields. Not having much time at disposal, I was only able to examine them very cursorily, and the notes which I now have the honour to forward to you upon them should be regarded as of impressions gathered during a hurried and necessarily imperfect examination, and not as opinions formed after complete investigation. Time did not permit me to see all the places where work was in progress in these districts, and I was sorry to have to pass by the Macquarie and Madam Howard mines, M'Cusick's Creek, and Hall's Creek, without stopping to see them. The mines visited were the Guilfoyle, Sovereign, King River, Princess River, Woody Hill, Mount Lyell, West Mount Lyell, North Mount Lyell, and Idaho mines. A good deal of work always goes on during the wet season in the creeks and gullies draining into the King and Queen Rivers, giving a subsistence to a considerable number of men, but I was able to see but very little of this.

The road to these fields from Strahan has been greatly cut up this winter by the heavy traffic passing over it, there being several teams constantly on it carting ore down from Mount Lyell, and taking up stores and building material. This traffic now goes out by the Howard Plains over the new road lately constructed by Government to the Queen River Forks, and thence to Mount Lyell over a section made by the Mount Lyell Company. From the junction with the old road at 15 miles from Strahan this new road is on the whole fairly good, though there are a good many very bad places in it, but from the junction to Strahan it is in very bad condition almost throughout, and bids fair to become impassable unless extensive repairs are at once carried out. The repairing work is quite beyond the power of the small gang of men now employed at it, and they can only patch the very worst places as a makeshift. From the 15-mile junction to Lynchford the road is fairly good, as there is not much heavy traffic upon it.

At the Nine-mile Plain on the road from Strahan a good deal of well-rounded waterworn gravel is seen lying on the bedrock beneath the surface soil, at an elevation of from 700 to 800 feet above sea-level, and pretty well on the top of a watershed. This occurrence is quite similar to that of the gravels found on the watershed between the Whyte and Savage Rivers and on the southern slopes of the Meredith Range (Lucy Spur, Frenchman's Spur, &c.), described in my recent Report on the Corinna Goldfield, and is at about the same elevation as the higher gravels there. From the top of a hill near the 15-mile huts, and from Mount Lyell, the general evenness of height of the lower spurs between the main range and the coast, and the consequent appearance of the country being a gently sloping plain, are very apparent, corroborating the opinion expressed in my Corinna Report that the lower-lying parts of the West Coast were formerly a plain of marine erosion, which has subsequently been deeply cut into by the modern watercourses.

The section of the strata of the country passed over in going from Strahan to Mount Lyell is in many respects similar to that seen between Zeehan and the top of the Dundas and Mount Reid Range, and probably the formation is of the same age. Beds of softish white sandstone, hard sandstone approaching quartzite, limestone, slate, and soft schist, generally striking from N.W. to N.N.W., and dipping as a rule westerly, are seen in both sections, and the fossils found are very similar, and go to show that both belong to the same geological system (probably Upper Silurian). On the lower slopes of the Dundas Range fragmental volcanic rocks, breccias, and felspathic tuffs are found, which seem most likely—though I know of no clear sections that would decide the point—to be interbedded among the ordinary sedimentary deposits, and near Lynchford we again meet with something of the same kind. The green rock seen in the vicinity of the King River Mine, which is indeed situated in the yellow decomposed portion of it, is clearly of a tufaceous or fragmental character, consisting of angular fragments of felspar, quartz, and older cherty rocks cemented together by a greenish groundmass, probably largely consisting of hornblende or augite, though neither of these minerals is recognizable with a lens. Pending microscopic examination, I

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should term this a greenstone tuff, so as to use a comprehensive name. In places the tuff is laminated parallel to the enclosing slates and schists, and at one place, about a mile from Lynchford towards Mount Lyell, I observed a bed of it lying conformably between layers of schist. At Mount Huxley too, as described in my recent Report, there are tufaceous rocks, and some very similar to these are seen on the new road from the Queen River Forks to Mount Lyell. These appear to be of a more felsitic character.

On Mount Owen and parts of Mount Lyell there are immense beds of conglomerate which are conformably bedded with sandstones and schists similar to those seen further westward in the section: it seems most likely that these too are of Upper Silurian age. The beds of conglomerate are much twisted, sometimes lying at flat angles, sometimes dipping nearly vertically, and the strike varies a good deal. In this they resemble the exactly similar conglomerates of Mount Claude and Stormont. It is not certain that the schists containing the Mount Lyell pyrites deposits are of the same age as the conglomerates of Mount Owen, but the presumption appears to be that they are so, there being as yet no evidence, so far as I know, of their being of more ancient formation.

Guilfoyle Mine.—This is situated near the Guilfoyle Creek, on section 15-93 leased to Mr. J. Elliott. The creek is said to have given good returns to the alluvial miners who worked it, and a good deal of search has been made for the reef or reefs from which the gold has been derived. A great deal of quartz is lying about the surface of the above section, and some years ago several small shafts were sunk and a short tunnel driven, but nothing of value was obtained. Lately, however, Mr. Elliott has been more successful than his predecessors. After driving S. 80° W. about 45 feet through soft schist country he struck a reef carrying gold, which has been followed N. 55° W. about 45 feet. The dip is to the N.E. about 41°. There is from 2 to 3½ feet of quartz, but it is a good deal broken up and rubbly, but seems somewhat stronger in the floor of the drive. It seems likely that it will be found less disturbed when sunk upon. Very fair prospects can be washed from the reef, and gold is pretty frequently visible in the stone. It seems to be associated with pyrites, the gold being often in vughs where pyrites crystals have been removed by oxidation altogether or in part, but it is also to be seen every now and then in the solid quartz as well. This is a reef well deserving to be prospected, there being a really very fair show of gold in it. It has not yet been opened up enough to enable it to be said confidently that it will be a payable mine, but what has been found is quite good enough to demand a further trial. It would not require very much money to sink a shaft 50 or 100 feet below the present adit level and test the mine pretty thoroughly.

Sovereign Mine.—(2-94, 3-94, 4-94, 5-94,—in all 40 acres.) In section 3-94 a tunnel is being driven into the eastern side of the spur on which the workings of the King River mine are situated, the intention being, I understand, to try to cut the King River reef. The country is yellow decomposed greenstone tuff, often traversed by black ferruginous and manganiferous veins, lying generally rather flat. One of these is reported to have yielded a little gold. Without a survey to show the relative positions of these workings and those of the King River Company, I cannot express any opinion as to the chances of this mine getting the King River reef.

King River Mine (Sections No. 62 and 63).—Very little is now to be seen of the workings of this old mine, as they have become closed up and inaccessible. Several exceedingly rich bunches of specimens have been at one time and another obtained, but the general average value of the quartz from the mine has been very low. Lately the mine has been let on tribute, and the tributers were successful in getting a rich bunch of specimens, nearly six pounds in weight, soon after they started. They have been going on somewhat different lines from those followed by the former miners, devoting attention more to some soft material lying on the foot-wall of the quartz body than to the latter itself. On the top of the hill they have made an open cutting, from which a crushing has been taken, the material being country rock (weathered yellow greenstone tuff) full of veins of quartz and oxides of iron and manganese; this has been found gold-bearing for as much as 12 feet in width. In the main tunnel near the battery some stoping was done on similar stuff lying on the footwall of the reef immediately under the quartz, but the workings could not be kept open on account of the pressure and dangerous nature of the ground, a great part of which was stoped out some years ago. When I last visited the mine the tribute party were trying to get to the footwall of the reef at a place where the ground had not been previously worked. Their success in treating the soft footwall material instead of the hard quartz renders it possible that a mistake may have been formerly made in mining only the latter, but on this point it will be best to suspend judgment until more work has been done, as it seems hardly likely that good gold-bearing material was consistently passed over during all the time the mine was formerly at work. The tributers have indeed proved that at the top of the hill and in one or two places at the adit level the footwall material has been worth crushing, but I hardly think this justifies the belief that throughout the mine the footwall is the auriferous portion, and that a mistake has been made by leaving it while taking out the quartz.

Owing to the old workings being difficult and dangerous to re-open, it is questionable what is the best method of further trying this mine. To open a new level below the adit a shaft and

column of pumps will be required. Before going to this expense it is only natural that the owners should wish to test the ground above the adit still further. The best chance of doing this seems to me to be by driving round the fallen-in ground to such blocks of the reef as have not been stoped out, but what is the extent of such blocks I have not been able to ascertain. If it can be shown in this way that the footwall continues to be auriferous, it would certainly be best to sink a main shaft and open a new level. The yellow country hitherto met with will almost certainly, however, give place in depth to undecomposed or little decomposed green rock, which will be much more expensive to mine. Along the reef itself there may perhaps be a chance of finding a softer belt of decomposed country.

It has been proposed to try to sluice the whole hill in which the workings are by hydraulic sluicing, but I do not think there is much chance of success in this. The country is very clayey, and will prove very difficult to break down, and tough to disintegrate in the sluices, while the gold is probably mostly in small quartz veins, which require crushing to set it free. It is very doubtful if the greater part of the gold would not be lost by being swept through the tail-races attached to quartz. If the clayey portion of the rock could be so thoroughly disintegrated that it could be washed clean from the quartz, and the latter then put through the battery, there would be much more likelihood of saving the gold, but I am afraid such a thorough separation is not practicable. Furthermore, there do not appear to have been any systematic tests made to determine if there is enough gold through the bulk of the ground to pay even for hydraulic sluicing. By carefully washing the old tips from the various tunnels in sluice-boxes a very good idea could be readily formed as to the average bulk value.

Another proposal has been made to crush the hillside from an open face, running everything through the battery. This, too, requires proof of the average bulk value before being further considered. Let a few test crushings be taken from various parts of the hill proposed to be worked, so as to ascertain what the battery can save from it, and then, if the results are encouraging, it would be time enough to think about crushing on an extensive scale.

Princess River Mine.—(Sections 72-92 and 94-92, in all, 15 acres.) It is now about four years since the Princess River Company ceased working this mine, after working it out pretty well down to the level of the lowest tunnel. After a time the sections were forfeited, and soon after were taken up in somewhat different shape by C. Grining and party, who secured the ground formerly held by the Princess River Extended Company in addition. A block of apparently poor stone left by the former owners was first stoped out, and improved very much as it was cut into, yielding 52 ounces of gold from between 60 and 70 tons of quartz. The amount of gold won above the tunnel level by the former Company was considerable, and the reason of stoppage of operations seems rather to have been want of means to sink a main shaft and open out below the tunnel than that they were convinced that the mine was not payable. The reef was poor in a winze sunk below the tunnel level, but was a strong body of stone, and worth following. The quartz in this mine crosses the strata of the country at a pretty high angle, and seems a well defined reef, likely to last downwards indefinitely. From the results secured above the tunnel it seems a fair venture to sink a main shaft, and provide it with machinery for draining the mine, and working it below the old ground.

Some little distance to the north from the main workings a tunnel has been driven to cut a reef in which some gold was found on surface. This has been intersected, and is found to be gold-bearing, in parts fairly rich, but much broken up and mixed with mullock. It will be necessary to follow it, and, if possible, sink on it, before it will be quite clear what sort of a reef this is. It may be a slide or fault in which quartz has formed, or it may be that a reef has been struck in a portion where it is soft and mullocky. As there is good golden stone in it, further trial is necessary. The slate country met with in the mouth of this tunnel is exactly similar to that seen in the old Company's main tunnel entrance, and is probably the same belt. If so, this discovery shows that the slate belt carries gold as well as the sandstone country, which proved richest in the old mine. In this, driving was suspended in the west end in a belt of quartzite, lying between the slate and the sandstone. Had the reef been followed a little further it would have left the quartzite and gone into the much more kindly slate country. This seems to me to be worth trying even now.

There is a good ten-head battery on the claim belonging to the Princess River Company, driven by a turbine. The principal item of expense in further developing the mine would therefore be the sinking of a main shaft, and equipping it with pumping and winding appliances. If the information given to me as to the value of the old workings is correct, it seems that there is great inducement to put down this shaft and try the reef again at a depth. The gold-bearing stone in possession of the present owners, both from the main reef and the new discovery to the northward, is of a good class, showing the gold well distributed through solid quartz; and as the reef has been proved to go down strongly in the winze below the main tunnel, there is much reason to hope that this mine will come to the front again. One thing in its favour is that it is close to the proposed Mount Lyell Railway line, which will be a great advantage in getting stores and machinery when the line is constructed.

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Woody Hill Mine.—(Sections 73-92 and 74-92, each 10 acres). This mine is situated close beside the new road from the 15-mile junction to Mount Lyell, about four miles from the junction. The reef crops out on the top of a small ridge on the eastern side of the road, where an underlay shaft has been sunk on it 85 feet, connecting with No. 1 tunnel. This is driven S. 70° W. 101 feet, the reef being cut at 96 feet; from the intersection the reef has been followed S. 33° W. about 200 feet, the drive connecting with the underlay shaft 54 feet from the cross-cut. Gold was obtained in the shaft, but towards the bottom dipped southerly out of it, and in the level was not got between the cross-cut and the shaft, but was met with again about 4 feet past the shaft. The reef crosses the country strata, mostly sandstone, very similar to that in the Princess River mine, and the shoot of gold dipping southward seems to conform to the dip of the enclosing rock. In the face of the drive the reef, which had been from 2 to 4 feet in thickness, has become small and rather poor. A fair pile of stone has been obtained from the level without stoping, and gold is often visible in this, while good prospects are got by washing the rubble; three tons sent to the Ballarat School of Mines are reported to have yielded 1½ ounces of gold per ton. The hill on which the reef was found slopes very steeply towards the north-east, affording excellent opportunity for mining by (unnels, and in order to open the mine at a greater depth a second tunnel is being driven 130 feet taccording to the manager, my aneroid made the height only 100 feet) below No. 1; this has been driven over 300 feet in direction S. 60° W., the country being slate at first, but afterwards changing to hard limestone and quartzite. At 270 feet a large body of quartz, 15 feet thick, was passed through, but was almost barren of gold. This tunnel has still some distance to be driven before the reef will be cut.

There is a nice show of gold in this mine, but the shoot so far proved is somewhat short, and the policy pursued of putting in a low-level tunnel before erecting a battery is therefore very commendable, it being of the first importance to prove the existence of a sufficiency of gold-bearing stone before getting machinery. When the reef is cut in the low level it would be advisable to drive on it both ways, in the hope of finding other shoots of gold. At present, as in the Princess mine, the sandstone country appears to be the most favourable for gold, but the reef has not been tested in the slate belt. It might be worth trying if the large reef cut in the lower tunnel improves to the northward when it passes into the slate country met with near the entrance. As the reefs are crossing the strata, there is a great likelihood that their gold value will vary with the different sorts of country rock passed through.

Mount Lyell District.

Mount Lyell Mine.—This mine has been previously described in my Report of 6th April, 1893, and it is only necessary now to describe the progress made since then. As mentioned in that Report, a discovery of rich ore was made in a winze on the eastern wall or footwall of the pyritic ore body, and soon after my visit this became of very great importance, increasing in richness and size. To work it to better advantage a vertical engine shaft has been sunk in No. 4 level, 27 feet south of the rich ore winze, to a depth of 100 feet, and two levels have been opened from it at 50 and 100 feet below No. 4. (Since my visit another level also has been opened at 75 feet.) Another shaft has also been sunk from No. 4 level, at the point where it first strikes the wall of the pyrites mass, to a depth of 105 feet, and from the bottom of it a crosscut is driven westerly to cut the ore. Both shafts go into the footwall of the deposit, as the latter has a decided underlay westward; in the ore-winze it seemed formerly that the underlay was to the eastward, but it has since been found that this was an abnormal feature not shared by the main mass of pyrites. Owing to the underlay some little distance has to be driven from the bottom of the shafts before the ore body is cut. Besides these shafts and the drives from them the principal other mining work done since my last visit has been the driving of another tunnel, No. 5, from the Linda Creek, at a level 151 feet below No. 4; this is still in progress. The company has, however, done a great deal of important surface work in addition, having constructed a cart-road from the Queen River Forks to the mine, and gone to great expense and trouble in surveying a route for the railway. Numerous trial surveys were made, and finally the route from Pine Cove up the King and Queen Rivers has been adopted, portion of the line being intended to be constructed on the Abt system. A topographical survey of the country between the machinery site at the Queen River Forks and the mine has also been completed. This will be of the utmost service in laying out the tramways and other connections between the mine and the smelting works.

Further details of the above-mentioned underground workings may now be given, the distances and other figures quoted being understood as being correct on the date of my visit, 28th May last. Since then the workings have of course been considerably extended.

Engine-shaft, 50-ft. Level.—The level has been driven southerly along the footwall of the ore-body 130 feet, mostly through hematite, but in the face it was being taken between the pyrites and a layer of quartzite which had come in between this and the hematite, the latter being left to the eastward. The quartzite appears to be a layer intercalated between the hematite and the pyrites. The ore at this part of the workings corresponded with that found above in the higher levels on the footwall, being considerably richer both in copper and silver than the main mass, assays yielding

20 per cent. copper and 20 ounces of silver to the ton. This will be very valuable ore when the smelting works are erected, but is not rich enough to ship at present.

Northerly the level has been driven along the footwall of the pyrites 69 feet, going between the main low-grade ore-body and a mass of hematite and baryte, which separates this from the deposit of rich ore; the end of the drive is in almost pure baryte. The principal workings on the rich ore are at this level, but are of very irregular shape and difficult to describe. In the north end of the shaft the good ore lay almost against the pyrites body, but at once ran off at a high angle from it for 37 feet, then turned more westerly in a somewhat crescent shape as if going back to rejoin it. The ore did not go down any distance below this level, a floor of conglomerate coming in immediately beneath it, except in the northern end of the workings, where it seems to be going down. In the north-western corner of the chamber there is a seam of rich ore which has not yet been followed, which may lead on to further discoveries, and there is still remaining unbroken a good deal of very valuable ore which was not, however, thought good enough to send away under the existing expensive conditions of realisation. The winze from No. 4 level underlays at first to the eastward, following the ore, but soon bends back again to the westward. The shape of the rich ore pocket may be likened to a large semi-circular hitch, with flat floor, cut into the footwall of the pyrites body, the greater part of the hitch being filled with hematite and baryte, while rich ore lies between these and the wall and on the floor round the inner angle. The richest ore is a mixture of copper pyrites and argentite or stromeyerite, the rich bornite found close to No. 4 level being seldom seen lower down. This contained sometimes as much as five per cent. of silver. With the bornite a little arsenical fahl ore (Tennantite) was often associated. Alongside the richest ore there is a good deal of very rich copper pyrites, containing from 200 to 400 ounces of silver to the ton and downwards; but this has not generally been shipped as yet. The pocket of ore has been of phenomenal richness, as shown by the following figures, given to me by the underground manager, Mr. Powell:—From the chamber, engine-shaft, and level 293 tons of material were raised from an excavation of only 3893 cubic feet; of this 282 tons sent from the mine had contained 384,000 ounces of silver and 68 tons 10 cwt. of copper, while 16 tons had not been assayed at the time of making up the figures. From the winze 133 tons of ore were bagged and exported containing 146,000 ounces of silver and 33½ tons of copper. Not counting the 16 tons on hand, 415 tons of ore had been therefore raised, containing 530,000 ounces of silver and 102 tons of copper, or at the rate of 1277 ounces of silver and 24·6 per cent. of copper to the ton. Picked specimens have assayed as high as 4000 and 5000 ounces of silver to the ton. This splendid bunch of ore has supplied funds to the company to complete all the mining and surface works above-mentioned, and has given a very substantial surplus besides. At the time of my visit it seemed rather probable that it was becoming exhausted, but there is great hope that it may yet be found to continue downwards, and that other similar pockets will be found. It cannot, however, be too often repeated that the main value of the Mount Lyell ore deposit lies in the low-grade pyrites present in such enormous quantities.

A good deal of quartz is found with the rich ore, quite similar to that usually met with in true lodes, a feature not yet seen in the main ore-mass, which is remarkably free from silicious matter of any sort. This strengthens the theory that the rich ore is of secondary deposition, formed from solutions charged with mineral matter percolating from the main body into the footwall country. The universal presence of such solutions in the wall-rock is now well seen where the No. 4 tunnel passes through this before striking the lode, for this portion is now covered with efflorescences and incrustations of blue sulphate of copper. The steam pipes from the battery boiler to the engine shaft pass along this tunnel and make it warm and dry, and consequently as the solutions ooze out of the pores of the country they are evaporated, and deposit their mineral contents. In the immediate neighbourhood of the ore-body it is reasonable to suppose that the solutions carry even more copper than those depositing the incrustations near the mouth of the tunnel, and along the footwall the circulation would probably be at its greatest. Any cavities and breaks in the rock there would be likely to become filled with secondary deposits. An interesting feature in connection with the probable mode of reduction of the soluble sulphates of copper and silver to the insoluble sulphides, is that at several places near the rich ore veins filled with lignitic substance are met with, showing the presence in notable quantities of carbonaceous matter, the very reducing agent most suitable for de-oxidising the sulphates. The lignite veins are plainly formed long after the enclosing rock, and are no doubt fissures through which swamp water and decaying vegetable matter have found their way down into the ground from surface. A similar lignite vein is seen in the North Oceana tunnel at Zeehan; and in the Cabbage-tree Hill at Beaconsfield, in the lower levels of the Moonlight mine and some of those of the Tasmania, there are very large quantities of it filling all the crevices and joints of the rock, which is there much fractured. In the Mount Lyell mine these lignite veins often carry very considerable quantities of silver, showing that the percolating sulphates have been reduced to sulphides while passing through them.

As there can be little doubt that a great deal of leaching of sulphates of silver and copper from the main body of pyrites has gone on more or less all over it, it is extremely unlikely that the rich pocket of secondary ore now known is the only one that has been deposited, and much more probable that numerous others will exist wherever the wall-rock affords suitable lodgment for

them: some of them may take the form of ordinary lodes or mineral veins running off into the country from the great ore-body, and it is also likely enough that where this itself has been fractured by earth-movements, veins of rich secondary ore will be found traversing it. The exploration of the footwall, especially from No. 5 tunnel, is therefore likely to result in further rich discoveries, and should be carried on as vigorously as possible. It also seems to me advisable that the hanging-wall of the pyrites should be prospected, as there is considerable probability of rich secondary ore being found there also. The operations of the West Mount Lyell Company are likely to give information on this point.

Since my visit to the mine, I note from the Mining Manager's published Reports that the winze on the rich ore at the 50 feet level went down on it for 14 feet, then the vein dipped westward out of it, the winze being continued down to connect with the intermediate level at 75 feet. I also gather that up to June 28th the ore raised amounted to 473 tons, containing 571,003 ounces of silver, and 112¼ tons of copper.

Engine-shaft, 100-feet Level.—At this level a cross-cut put in to the westward passed first through 14 feet of conglomerate, then 16 feet of schist; next a bed of hematite one foot thick, evidently deposited contemporaneously with the enclosing walls, was passed through, then schist and quartzite country to 50 feet, where the pyrites mass was struck. At the time of my visit this had been penetrated for 26 feet.

No. 2 Shaft.—This was sunk in conglomerate to a depth of 105 feet, and at 100 feet a cross-cut was put in to the westward. From the Manager's published Report of June 14th, it appears that the pyrites mass was met with at 53 feet from the shaft, assaying much the same as in No. 4 level above.

No. 5 Tunnel.—This tunnel has a course about south 20° west, and should strike the ore-body 30 feet south of the engine-shaft. On June 28th, it was in 667 feet; it has to go 950 feet to join with the workings from the engine-shaft, which is to be sunk to connect with it, and about 1000 feet to strike the pyrites. The mouth of the tunnel is close to the Linda Creek, and is in the black laminated clay bottom seen in the alluvial sluicing workings close by. This black clay seems to be of considerable thickness and extent, and underlies the alluvial gravels in several places down the Linda Creek; it is probably of Tertiary age, but, I do not know of any fossils having yet been found in it which would determine this. After passing through a considerable distance of black clay, the tunnel entered a brown ironstone mass, probably a bed of bog iron ore. This was passed through for a long distance, but as yet has not been found to contain any metal of value. Somewhat soft conglomerates, more like cemented gravel than like the hard silicious conglomerates of the Mount Owen formation, were next met with, apparently lying rather flat but in wavelike folds; in the face when I saw them the strike of these beds was from N.E. to E.N.E. and they were dipping N.W. about 50°. I am in considerable doubt as to whether these beds belong to the same series as those enclosing the pyrites or not; it seems very possible that they are altogether younger. Further examination of the country than I had time for on my visit would be required to make the matter clear. The gossan formation in this tunnel also requires further investigation, as it might possibly be the cap of another pyrites lens, though it seems more likely to be of superficial origin.

West Mount Lyell Mine.—According to the plan of the Mount Lyell Mine, the mean course of the footwall of the pyrites ore-body is about N.N.W. in No. 3 level, and about W.N.W. in the No. 4, the mean strike being therefore about N.W., which agrees pretty well with the general strike of the strata of country exposed at surface. On the West Mount Lyell Company's property, to the N.W. of the outcrop of the pyrites lens, the ore-body is not seen, a large mass of quartzite apparently taking its place. On the boundary between the two Companies' properties a shaft is being sunk by the West Mount Lyell Company, in the hope of striking the ore at a greater depth. At the time of my visit this was down 70 feet, and had passed through much conglomerate carrying hematite, and also a few veins of pyrites and some baryte. At a greater depth it seems very likely that the pyrites mass will be struck, as it underlays to the westward. Further north, under the quartzite hill, a tunnel has been driven 140 feet, the first 90 feet being in softish schist, and then fine grained hard flinty chert or quartzite being encountered. Reddish stains of hematite are often seen in this, and sometimes a good deal of specular iron.

It seems very possible that the quartzite really represents portion of the filling of the old lagoon in which the pyrites mass was originally deposited, it being quite likely that portions of this would be invaded by sand and mud brought in by streams. We may imagine the original basin of deposition to have been filled with pyrites in the central deeper portions, and to have had ordinary sand and mud in the shallower marginal parts. Owing to the tilting of the strata we now find the deposit standing on edge instead of lying flat as at first, and consequently it is quite conceivable that the outcrop may consist at one place of the pyrites and at another of the marginal sediments, according as the shape of the old shore-line of the lagoon was more or less irregular. If this is the explanation of the presence of the chert rock on the line of the ore-body, and it seems very likely, it is probable that the West Lyell tunnel is too high to do any good, and that exploration will have to be

carried on by sinking shafts or boring through the chert: a diamond drill would be very useful here. In the Mount Lyell mine a good deal of chert is found on the footwall of the lens of pyrites, very similar to that on the West Lyell hill, and it is pretty evident that this chert is only a portion of the ancient sediments of the basin of deposition, so it seems very likely that the large chert masses have the same origin.

The use of a diamond drill in prospecting for these large pyrites bodies was suggested in my former report on this district, and further examination only confirms me in the opinion that a great deal of necessary preliminary work in testing the deposits could be better done by boring with these machines than by ordinary mining. The conditions are much more favourable for their employment than in the case of ordinary lodes, where the mineral vein sought for is small and might be easily passed through where thin or poor. As a cart-road now exists from Strahan to Mount Lyell I would advocate the use of the drills as being much more expeditious and cheaper than shaft-sinking.

North Mount Lyell Mine.—This mine lies nearly a mile to the north of the Mount Lyell mine, and contains a body of similar pyrites, which has been taken to be portion of the same mass. It seems to me, however, almost certain that this is an entirely different lens, parallel to the main one; the occurrence of such parallel lenses is a common feature of large pyrites deposits. As above pointed out, the strike of the Mount Lyell mass is about N.W., and in going along the track from it to the North Mount Lyell mine numerous observations of the strike of the strata showed them to be running also about N.W. on the average. The laminæ of the pyrites body of the North Mount Lyell mine are also running about N.W., and the strata in the tunnel have the same course. The lenses of pyrites being stratified conformably with the enclosing country, it follows from this that the North Lyell mass must lie very considerably to the eastward of the Mount Lyell one, and be separated from it by a great thickness of strata.

Very little work has been done on surface in this mine, though several trenches have been cut. In one of these a body of pyrites is seen, upwards of 30 feet wide, but not properly laid bare, so that its true size cannot be discerned. Some of this ore is said to have yielded on an assay 28¼ per cent. of copper, 4 ounces of silver, and 3 pennyweights of gold to the ton. Several other trenches reveal the presence of the pyrites mass, but are not deep enough or long enough to give much information about it; it seems pretty certain, however, that it is of considerable size, and running a north-westerly course. A tunnel is being driven to cut it well below the surface. It was in 230 feet at the time I saw it, and the manager told me he expected to have to drive over 300 feet before he reached the ore. The course of the tunnel is about N. 30° W., and as the strata are running N.W. they are cut through very obliquely. About a chain in, after passing through schist and some very hard quartzite country, soft clayey stuff was met with containing at times nodules of harder schist; this looks much like the material found in large cross-courses, but is, I think, only the superficial portion of a soft stratum of rock. Close to the face a body of quartz was struck, running about north, consisting of silicified schist impregnated freely with copper pyrites and bornite. At the time I saw it it had not been cut through, so the size was not apparent. It had not been assayed either. Should the copper minerals in it carry silver it might be worth crushing and concentrating. Being silicious ore, it would be very suitable for use in the Mount Lyell smelting works as flux for the pure pyrites ore.

There are several outcrops of hematite on this property and west of it, but they here appear to be not associated with pyrites as at the Mount Lyell mine; there may, however, be pyrites at a greater depth.

Idaho Mine.—The lode or ore-body of the North Mount Lyell Mine can be traced south-east into sections 12-92, 6-92, and 28-93 as a succession of outcrops of brown iron ore (gossan). Where this line is cut across by a small creek a great deal of native copper was some years ago obtained by the Stanley Company, which then held the ground; in all 40 tons of native copper are said to have been obtained. Right along the line of the gossan there appears to be more or less native copper in the surface soil, and there can be little doubt that this originates from sulphate of copper, from the underlying pyrites body being reduced by the organic matter of the surface soil.

A tunnel is being driven to cut the line of the gossan: it was 80 feet long when I saw it, and was going through soft clayey stuff containing seams of gravel, evidently a comparatively recent formation, and not the main country rock. A good deal of native copper in small scales and crystalline pieces occurs through this material, especially in ironstone nodules enclosed in it. The tunnel is to go some 300 feet in order to be under a shaft 50 feet deep, known as Greenwood's shaft, sunk some years ago.

From the large quantity of native copper that exists along the line of the gossan, and the fact that this corresponds very well with the position in which the North Lyell ore-body should be expected to be found, I think there is little doubt that a considerable body of cupreous pyrites must exist in this property, and it is certainly well worth prospecting.

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General Remarks.—It would be very advisable to have an extended geological survey of the Mount Lyell District as soon as possible. There are several matters which require investigation in some detail with respect to which a geological survey would probably give much information of very practical value. It would be very useful to ascertain the strike of the strata at different points throughout the district so as to know where to look for the pyrites lenses, for, as the country beds vary in strike so also will the enclosed ore deposits. It is also important to ascertain what relationship, if any, exists between the deposits of hematite and those of pyrites, so as to learn if the former are derived from the oxidation of the latter: at present it seems to me most likely that the massive hematite bodies have never been pyrites at all, but were originally beds of brown iron ore. Another object of a survey would be to determine the extent of the recent formation overlying the older rocks seen in the cuttings on the roadside coming down from the saddle between Mount Lyell and Mount Owen: the prospecting of the ground covered by this would be facilitated thereby. The black pug met with in the mouth of the No. 5 tunnel of the Mount Lyell mine probably belongs to this superficial formation. The relations of the conglomerates and sandstones met with in the same tunnel and of the quartzite beds seen in the Linda Creek to the main ore-bearing formation also require elucidation, there being some reason to suspect that they are of different age altogether. By means of the survey it is probable that such a knowledge of the district would be obtained as would greatly assist in the development of the known mines and in the opening of new ones, and might perhaps prevent expensive mistakes.

It may be mentioned that a bed of very fair limestone has been found on the side of one of the roads leading down to the Linda Creek; it probably belongs to the same formation as the quartzites seen a little higher up the same stream. This limestone may prove useful for flux for the smelting works.

Another noteworthy feature that I regret time did not permit me to examine further was the occurrence of what seems to be a large erratic boulder of diabase greenstone not far from the above limestone. Ice alone seems able to account for the presence of this erratic block, and it is a matter of great consequence to the development of the district to ascertain if the Linda Valley has really been the seat of a glacier, as this would lead us to suppose. Ice is so potent a geological agent, that any traces of its former presence cannot be disregarded, else we are liable to fall into serious errors. For example, under ordinary circumstances stones from the outcrop of a lode work their way down hill into the water-courses, and can be often traced upwards to their source; but ice may carry them in an angular unworn condition for miles, over considerable ridges and valleys, and finally perhaps deposit them even higher than where they were taken from. A prospector finding such ice-borne blocks would waste his time hopelessly hunting for the parent lode according to the usual rules.

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

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

The Secretary for Mines, Hobart.

WILLIAM GRAHAME, JUN.,
GOVERNMENT PRINTER, TASMANIA.