REPORT ON THE STATE OF THE MINING INDUSTRY ON THE WEST COAST.

Inspector of Mines and Geological Surveyor's Office,
Launceston, 25th April, 1890.

SIR,

I HAVE the honour to report to you on the state of the Mining Industry on the West Coast of the Colony, as observed by me during my recent visit there.

MOUNT LYELL DISTRICT.

This was the first mining centre I went to. There is a fairly good cart-road from Strahan to Lynchford, and from the latter place to Mount Lyell there is a road wide enough for sledges. This part of the road is not well laid out, the grades being much too steep for anything but a pack-track. To make a cart-road of it numerous deviations from the present track will have to be made. I am convinced that true economy demands that the roads in these mining districts should be laid out so that they may develope from pack-tracks into cart-roads by simply widening and forming them from time to time. Easy grades are of much more importance than short roads, especially in a district where horses and horse-feed are very expensive. A bad road causes a very heavy tax to fall on an out-of-the-way place in the increased expense of obtaining all supplies. The difference in first cost of a good and a bad road is soon lost in the extra expense of transit over the latter, and it should be borne in mind that this extra expense is dead loss to the country. A country requiring a larger population to develope its resources cannot afford to employ its men in unreproductive work, and the extra labour involved by bad roads could be employed to advantage in other directions. The makeshift character of so many of the roads in the mining districts of the West Coast is such a charge upon the industry that I feel compelled to call attention to the falseness of the economy. An example of the extra expense involved by one or two bad grades is to be seen in the road from Remine to Mount Zeehan. This is on the whole an excellent road, but there are one or two very steep grades in it which compel the employment of three horses instead of two for every cart that passes over it.

At Mount Lyell I examined the extraordinary deposit generally known as the "Iron Blow," worked by the Mount Lyell Gold Mining Company, and the alluvial claims of the Linda Company and of Messrs. Carlson Brothers and Delaney. There are other alluvial claims in the district, and there is also a place where native copper, said to be auriferous, has been found in some abundance, but I was unable to visit these. The Mount Lyell Company's gold-bearing deposit is of a most unusual character. It consists mostly of red oxide of iron (Hematite), sometimes micaceous. This iron ore is partly in hard solid metallic-looking masses and partly earthy and soft. Gold occurs in both sorts of the ore. Portions of the iron ore are hydrated and changed to yellow and brown oxides of iron. Iron pyrites is frequently found in this portion of the stuff. On the western side of the hematite is a large mass of iron pyrites, the relation of which to the rest of the deposit is as yet difficult to make out. In a drive into the working face a lode of copper pyrites was encountered, but this I did not see, as the drive was blocked up. In the lowest level yet driven into the ore-mass the red hematite is still found on the eastern side, and on the western side hard iron pyrites and a mixture of iron and copper pyrites with galena. A peculiar feature of the ore is the nearly entire absence of silica, its place being taken by baryte (heavy spar). A large open cutting has been worked in the outcrop, forming an irregular circular quarry 66 feet wide in the widest part, and having an average diameter of 42 feet. The face is about 50 feet high in the middle. The whole of this cutting is in the ore-mass, and on the western side of it lies the mass of iron pyrites above mentioned. No work has been done on this, and its extent can only be surmised from two to three surface trenches. It evidently extends over a large area. On the spur above the working face the outcrop of the hematite may be traced for about 100 feet, but trenching would probably trace it much further. The strike of the deposit appears to be as nearly as possible north and south, and extensions of it are said to have been found on this line a mile to the southward and for a long distance to the northward as well. The country rock is conglomerate and sandstone, probably of Silurian age at youngest. Silurian fossils are found in the neighbourhood, but I did not see any *in situ*, and cannot therefore be certain that they came from the conglomerate formation. The deposit is most likely a lode, the wide portion now worked being one of those bulges which are not uncommon. The pyrites on the western side of the cutting may possibly prove to be another lode coming into the hematite one. More working must be done before the relations of the pyrites and the hematite to each other are quite clear.

Gold is readily obtained in the prospecting dish by washing the softer parts of the hematite. The battery returns show that silver is also present in some quantity. Much of the gold is very fine and flaky, and is very easily washed out of the dish. The large amount of baryte present in the ore makes it very difficult to save the gold in washing off, and the prospect obtained from the tailings of the dish washed is nearly as good as the first one. The iron ore also is heavy. This heavy character of the gangue is greatly against the successful treatment of the ore in the battery, and in consequence there have been many complaints as to loss of gold. A small tailing-pit close to the battery, and two larger dams some little distance away from it, have therefore been constructed to impound the tailings for further treatment. Assays have, I am told, been made of the tailings from time to time in a desultory sort of way, but no attempt appears

to have been made to secure a regular and systematic sampling of the tailings in order to ascertain the exact amount of loss. This ought to be done in every battery, but most especially in such a one as the Mount Lyell Company's, where heavy loss of gold is to be feared from the nature of the ore. It is not enough to take occasional samples from the heavy tailings that accumulate in the settling pits, for the fine slime, constituting often 30 per cent. or more of the whole bulk, frequently is even richer than the sand, and all the slime escapes suspended in the water. To take a fair and accurate sample of the tailings from a battery a small portion of the stream of water and tailings issuing from the mill-house must be continuously or at regular intervals diverted into a special settling-tank large enough to give time for all the sediment to settle in it. At the end of a week an assay sample taken from this sediment, after mixing it thoroughly, will correctly represent the composition of the whole week's tailings. There are numerous mechanical sampling machines in use, mostly of American design, which act excellently. A simple and effective sampler can be easily made as follows :—The whole of the tailings from the mill are gathered into a launder. At any convenient place this launder is made to discharge into another one set about six inches lower down, so that the water drops in a small waterfall from the higher into the lower launder. Immediately under the fall are placed six or more small metal pipes, distributed as evenly as possible over the whole space on which the water falls. These pipes are placed vertically, with their tops, which are open, sufficiently high to be above the level of the water as it runs away in the lower launder. A small proportion of the whole discharge falls through these pipes into a shoot fixed underneath the lower launder (through the bottom of which the pipes pass). The shoot carries this small portion into a large settling-tank, where the sediment is allowed to accumulate as long as may be desirable. When the sediment is thoroughly settled the water is syphoned off, and the sediment is thoroughly mixed with a shovel, and a portion is taken from it to be dried and sent away for assay. The cost and trouble of the whole arrangement are trifling, and a thorough check on the efficiency of the battery is established. Such checks on the battery work are most necessary, even when the mill is working well, as any blunder or piece of carelessness on the part of those in charge almost inevitably results in loss of gold and consequent higher assay of the tailings, and an inquiry into the reason of the loss is at once instituted. Close attention to the work in hand and careful treatment are thus ensured. When the loss of gold in the tailings is great, efforts are sure to be made to reduce it, and to improve the gold-saving appliances; but when the amount of loss is unknown, as is the case without one exception, so far as I know, throughout the whole of the Colony, it is a very easy matter for the battery men to persuade themselves that nothing of consequence is lost. It is notorious that, as a rule, battery managers know absolutely nothing as to what they are losing.

From the manager of the Mount Lyell Company's mine I learned that 1530 tons of ore had been crushed in the battery for a return of 1480 ounces of bullion, about half of which was gold and half silver. He also told me that assays of the ore generally gave a return of silver that would be payable if it could be cheaply recovered. The battery treatment is not capable of saving silver except when in the native state or alloyed with gold. Chloride of silver can be amalgamated readily, but requires time. The other compounds of silver can mostly be amalgamated if treated for a long time in iron pans heated by steam, with salts of copper, common salt, and other chemicals. The ordinary battery treatment does not recover these compounds at all. In order to make the most of the ore, it will therefore be necessary at Mount Lyell to improve the treatment now in use.

The reduction plant at present consists of an eight-stamp battery with amalgamated copper tables and blanket tables, and one Wheeler pan. The manager was erecting shaking-tables and a small amalgamating device of his own, at the time of my visit. The whole battery was sadly defective. The same remark, I am sorry to say, would apply more or less to everything about the mine. The working face was in such a dangerous condition that I had to order the removal of several threatening rocks at once. The arrangements for getting the ore from the working face to the battery were also very badly arranged for economical working. The stuff from the face was wheeled in barrows for nearly a chain, and thrown down a pass directly into a truck, no proper hopper being provided. The loaded truck was then driven out by two men, being too heavy for one by himself, and tipped into a hopper at the head of a self-acting grade or wire tramway. I could see no reason for not bringing the tramway right up to the floor of the working face. The tramway was in a wretched condition—hardly any of the rollers would revolve, their axles being too thin, and allowed to project too much. At the bottom of the grade the trucks ran into a self-tipping arrangement constructed much too flimsily for its work: I was not surprised to see a truck jammed in it. From the tip the stuff runs right down on to the feeding-floor of the battery, interfering very much with the work of the feeder. A hopper ought to be provided to take this stuff. Underground, in the level driven on the lode, the same unworkmanlike state of affairs was evident, the drive being extremely crooked, without any apparent reason for its crookedness. It is only fair to the present manager, Mr. Crotty, to say that he had only taken charge of the mine two days before my visit, and cannot therefore be held responsible for the state of affairs, which he was doing his best to remedy.

The style of machinery that should be used for this ore requires to be selected with much consideration. If silver is present in payable quantity, as I was told it is, it is a matter of consequence to save it as well as the fine gold now lost. The treatment of silver ores by amalgamation depends on the nature of the compounds of silver present in them. The process most likely to give a satisfactory result is that of pan amalgamation. As the Company has a Wheeler pan in the mill, it would not be difficult to give this process a fair trial. The pan should, however, be worked in connection with a settler in order to do justice to the ore, as the pulp in the pan ought to be worked to the consistency of honey, and then thinned with water in the settler in order to recover the quicksilver and amalgam. As the pan amalgamation process does not appear to be well known in this Colony, a short outline of it may be necessary. It is designed to effect and ensure intimate contact of the precious metal with quicksilver. For this purpose the finely ground ore is mixed with enough water to form a "pulp" thick enough to prevent the easy settlement of quicksilver through it. The ore is crushed by means of stamps and passed over copper tables in the usual way, thus saving the heavier gold. From the copper tables the crushed ore passes into a series of six or

more large settling-tanks of sufficient size to prevent the loss of much sediment. From these it is shovelled into the pan, the muller of which is revolving. Enough water is added with the sand to thin it enough to allow the muller to work freely. The quantity of water added should not be so great as to prevent the ore from eventually working to the proper honey-like consistency. The muller is lowered so as to bear heavily on the bottom of the pan and grind freely. In the course of from one to two hours all the heavy sand is thus reduced to a fine slime, and the contents of the pan become "pulp." From 100 to 300 lbs. of quicksilver, according to the size of the pan, are now put into it, together with quantities of common salt and sulphate of copper (bluestone), which must be as determined by a few experiments. For a charge of quarter of a ton of ore in the pan, 6 lbs. of salt and half a pound of bluestone might be tried to begin with. If the bullion got from the pan is found to contain too much copper, say more than 20 per cent., the quantity of bluestone used to a pan charge must be reduced. But if the bullion contains less than 5 per cent. of copper, more silver would most likely be saved if a little more bluestone were used. In this process it is better to produce somewhat coppery bullion than to lose silver by reducing the quantity of bluestone too much. These chemicals, as the salt and bluestone are generally termed, may be added along with the ore when charging the pan. Some millmen also add the quicksilver immediately the ore has been introduced, but it is generally preferred to keep the quicksilver back till the coarse sand has been finely ground. While the grinding is going on steam from a boiler is injected into the pan, raising the temperature of the contents to boiling point. This greatly facilitates the amalgamation of silver. To prevent loss of heat the pan is furnished with a wooden cover. After adding the quicksilver the muller of the pan is raised a little so as not to grind any longer, and it now churns the quicksilver and contents of the pan together. This process continues for from two to four hours, at the end of which time fine globules of quicksilver may be seen thickly in the pulp adhering to a stick dipped into and withdrawn from the pan. The fine globules of quicksilver, circulating constantly through the whole mass of ore, come in contact with and amalgamate even very fine gold. The function of the chemicals is to convert compounds of silver which do not readily amalgamate into such as do so with ease. When the amalgamation is judged to have proceeded far enough, more water is added to the pan, and its contents are washed out into the settler, the stirrer of which is set revolving. In the settler the pulp is thinned with water sufficiently to allow the small globules of quicksilver and amalgam to settle to the bottom. The water, carrying the fine tailings suspended in it, is gradually run off by means of a number of nozzles set in the side of the settler at different heights. The settler is usually made large enough to take the discharge from two pans, and should work off its charge in the same time as is taken to amalgamate a charge in the pan. The quicksilver in the settler is generally drawn off by means of a syphon in the bottom of it after about an hour's working, and is squeezed through canvas to extract amalgam. The quicksilver is then ready in time to go back into the pan. This process has been used with great success for ores containing fine gold and compounds of silver, as well as for the latter by themselves. When gold alone is to be saved the use of chemicals and steam is unnecessary.

As amalgamation is one of the cheapest methods of treating gold and silver ores, and is, besides, an easily learned and easily understood process, it is generally found to give better financial results than more expensive processes or such as require special skilled knowledge, even when the latter save a larger proportion of the assay value. It is therefore wise, as a general rule, to exhaust the resources of this process before resorting to chlorination or smelting.

The sulphide ores at Mount Lyell could not be treated by any amalgamation process with any success without a preliminary roasting to get rid of the sulphur. Only the hematite ore is fit for the raw amalgamation process above described. I do not know if the pyrites contains enough bullion to be worth working. Very careful sampling of it would be required to give data to settle this point. If it should prove on assay to be valuable enough for treatment, the process of pyritic smelting would probably prove the best for dealing with it, and would have the great advantage that the hematite ores could be smelted with it as flux. Pyritic smelting, though well known to metallurgists, is almost unknown to the public generally, and a few words about it may not be amiss. If a mixture of auriferous and argentiferous quartz, oxide of iron, and pyrites, is smelted in a furnace the iron oxide and quartz unite to form a slag, while the pyrites and other sulphides that may be present melt and form what is called "matte." The matte is heavier than the slag, and is found as a separate layer beneath it when the molten contents of the furnace are run out. The matte is found to contain practically all the gold and silver in the furnace charge. In fact, the matte acts precisely as the metallic lead does in the ordinary smelting process. If now the matte is partially roasted so as to oxidise a portion of it, and this half-roasted material is again run down with siliceous ores in a furnace, a small quantity of matte, now very rich in bullion, is obtained. The treatment of this rich matte is generally entrusted to the skilled metallurgists of Europe, mattes being sold according to their assay value at Swansea and Freiberg from all parts of the world. This process would be very suitable for the ores found at Mount Lyell, and would most likely be found to be both cheaper and more effective than roasting the pyrites and then amalgamating.

Another process which those concerned in the Mount Lyell mine would do well to make inquiry about is that recently brought out by the Cassell Company, of Glasgow, and known as "Macarthur's Process." It is claimed for this process that it will extract both gold and silver from even the most refractory ores with great success. Cyanide of potassium is the solvent used to extract the metals. This is as yet an almost untried process, but it promises well enough to be worth watching. Works for trying it on a large scale were in course of erection at Waiorongomai, in New Zealand, some six months ago, but I have not yet heard what success attended the operations.

The peculiar nature of the Mount Lyell ore should make the owners take the precaution of having parcels of from one to five tons treated by various processes before finally deciding on the method of treatment and erecting machinery. The cost of such experimental trials would be nothing compared with the loss that would result from a wrong selection.

Before leaving this subject I would remark that the present battery site is not at all a suitable one, and that any new works put up by the Company would be much better placed on the flat-lying ground at the foot of the hill on which the mine is. A better supply of water could then be obtained, and there would be room for machinery which the present site does not afford. The mine is an extremely promising one, and ought to pay well when the difficulties of treating the ore are overcome.

All the alluvial claims at Mount Lyell had ceased sluicing for want of water at the time I saw them. For about nine months in the year they are able to sluice, but water runs short in the summer. The three claims visited have all done a good deal of work, and obtained a fair amount of gold. The bottom on which the auriferous gravel rests is a black peaty mud, full of roots, but this itself contains a little gold, and on Delaney's claim fair auriferous wash has been obtained below it. As the stripping of the surface gravel proceeds this black bottom will no doubt be prospected further, and it is quite possible that payable gold may be found beneath it. There is still a large quantity of wash-dirt to be sluiced in this neighbourhood. The Linda Company is hampered in its work by the difficulty of getting rid of the tailings, and is now constructing a long tail-race so as to work to more advantage. When this is finished it will allow the work to proceed on a much larger scale. The Carlson Brothers were also doing heavy dead-work, removing a large slip which had covered the wash-dirt. This was a really formidable work, and the energy with which it has been attacked speaks well for the pluck of the owners of the claim and their belief in its value.

Below the Linda Claim is an extensive swampy flat, through which the Linda Company's tail-race has been cut. From the configuration of the country this flat may be expected to be composed of alluvial materials of considerable depth, and gold is very likely to be found in it. It is quite possible that the streams which deposited the gravels in the claims higher up did not escape from this flat by the present outlet, but had some other channel. If this be so there should be an old channel or deep lead still to be discovered in this district. My visit was too hurried to allow me to test this conjecture in any way; but even if no lead exists, the country round here is promising enough to attract prospectors.

The black bottom on which the gravel rests is very full of segregations of pyrites, and a little vein of galena has also been found in it. Limestone has been cut in the Linda tail-race. The geological features of this upper part of the Linda Valley are of much interest, and I hope on a future visit to have time for their study and elucidation.

Queen River and Howard Plains.—From Mount Lyell I went to the new reef found by Messrs. Orr and Watson at the Howard Plains, now held by the Madam Howard Company. The track from Mount Lyell crosses several creeks running into the Queen River. Most of these have been worked for gold, and some have given very rich returns. So far reefs of value have not been found, but the presence of so much alluvial gold points to their existence. The character of the country, too—namely, old slates and sandstones, penetrated and overlaid by volcanic rocks,—is favourable for the existence of auriferous reefs, and in time they will, doubtless, reward the labours of the untiring prospector.

The ground held by the Madam Howard Company comprises four 10-acre sections, situated on the north side of the right hand branch of the Princess River. The reef crops out on a bare spur, and may be plainly traced on the surface for about ten chains. Strike 80° east of north, dip 58° southerly. Two small shafts, 40 feet and 25 feet in depth, were sunk on the underlay of the reef by the prospectors and connected by a short drive. About 13 feet has been driven westward on the reef from the 40-foot shaft also. As these shafts were not well constructed, the company's manager is sinking a new shaft a little further along the reef to the westward. The prospectors took from their workings about 20 tons of quartz, which was crushed in a small hand battery, and yielded 63 ounces of gold. The reef is of white friable quartz, so far very free from pyrites, and forms a solid body from 2½ to 3 feet in thickness. Fair prospects are obtainable from the stone in the prospecting shafts, and in the stone lying on the surface gold was pretty freely visible. The new shaft had not struck a solid reef when I saw it, but was only down 22 feet. The country rock is a grey sandstone, striking N. 47° E. and dipping to the N.W. at an angle of 75°. The reef cuts through the strata both in strike and in dip. The character of the country rock closely resembles that of the sandstones in the Beaconsfield District, and it belongs in all probability to the same Silurian formation. The property is situated favourably for working to a considerable depth by means of adits. A level about 270 feet long, driven from the gorge on the southern side, should cut the reef about 118 feet below the mouth of the new shaft, and a level 600 feet long would probably give 300 feet of backs. The battery would naturally be placed in the gully from which these drives must start. I cannot speak as to the possibility of driving the battery by water-power, but there is plenty of water for all other purposes.

A second reef, parallel to the prospectors' one, outcrops on the hill about three chains to the south of it. No work has been done on this as yet. It would be cut by the adits above mentioned. This property seems likely to turn out well; present appearances are all in its favour. Until it has been proved to a greater depth, however, investors should beware of putting too much faith in these. It is a great mistake to put a high value on a mine on the strength of a few tons of good stone from the outcrop. A mine has really no value as an investment until there is a quantity of payable ore in sight in it to guarantee interest on the money: till then it is a speculation. Investors in unproved mines should always be prepared to spend a good deal of money in developing them before expecting dividends, and should insist on seeing them opened before batteries and other surface works are undertaken. How often do we see crushing machinery erected only to be taken down again for want of something to crush? The King River and Macquarie mines, in this very neighbourhood, bear witness to the evil policy of prematurely putting up machinery.

As there was no work going on in the King River mine, and no one was in charge of it, I did not make any examination of it, though passing close to the workings.

Princess River.—Here three companies are at work, though not at present with any vigour. The Princess River Company and the Princess River Extended Company hold ground alongside one another, on a reef running through a high spur separating the Princess from the Queen River. The reef has been well tried by both, by means of adits driven from each side of the hill, but with poor results. Near the top of the hill and in the higher levels good stone was obtained; but lower down, though the reef looks strong and is well defined, it has not proved payable. The country rock is sandstone, quartzite, and slate, apparently much disturbed. Little more can be done on this reef by means of adits, and its further development will require pumping machinery of probably rather a powerful sort. The Princess River Company has a good 10-head battery worked by water-power. A little lower down the river the Princess River Prospecting Association have driven two or three short tunnels. In one of these a small reef has been cut, from which good prospects can be washed, and in some of the stone from this I saw gold freely. A crushing is being taken out to be tried at the battery, and, if this proves payable, a tramway is to be constructed to the battery. From another of the adits a strong stream of water has been constantly flowing for some time past, which augurs ill for the work of unwatering the mines below the level of the river. It is very much to be regretted that the enterprise of these companies has not been better rewarded. The most satisfactory feature is that the auriferous character of the formation has been proved, and that consequently there is good hope of better reefs being yet found.

MOUNT ZEEHAN DISTRICT.

The importance of this rich district requires a much more minute examination of it than the limited time at my disposal enabled me to make. I could not visit all the ground that has been taken up, nor see all the trenches and workings that have been made, but I saw enough to convince me that a great future is in store for this part of the Colony. The lodes are numerous, well defined, strong, and rich, and have every indication of being permanent in depth. I can see no reason for the croaking one often hears about this field having merely a "surface show." It is, doubtless, undeveloped as yet to any depth; but the richness, number, and extent of the good "surface shows" render it most improbable that equally good ore will not be found in depth. That there will be great variations in the quality of the lodes is to be expected; and it may quite well be that some of those that show the best on the surface may be poor when sunk upon, just as the converse is likely, namely, that lodes poor on the surface may become rich at greater depth. The lodes cannot be expected to be of uniform quality throughout, for such a character is unknown to mining experience; the rule being that the ore is distributed unevenly through the mass of the lode, sometimes forming thinner or thicker veins through it, sometimes in scattered grains throughout masses of gangue, and sometimes constituting for a considerable extent almost the whole thickness of the lode. We may expect to find "bunches" and "shoots" of ore in a lode, but we must not expect them to exist throughout its whole extent without interruption; and it is silly to fear that a mine has come to an end when the ore is found to give out, and be replaced for a time by worthless lodestuff. There is every probability of further exploitation discovering fresh bunches and shoots of ore. I make these remarks because timorous folk have felt scared at hearing that some of the Mount Zeehan mines have showed more carbonate of iron, barytes, and other gangue than galena when cut a little below surface. These barren portions are sure to exist in all the mines, and must be patiently driven through.

The belt of land taken up in the vicinity of Mount Zeehan is, roughly, eight miles long by four and a-half miles wide,—the longer sides of the rude oblong having a N.W. and S.E. direction. This is the strike of the principal lines of lode, of which there are several. The country rock consists of silurian grits, sandstones, and slates, having a general strike of from 65° to 70° to the W. of N., and dipping N.E. at high angles, from 65° to 80°. In many places the strata are much bent, and twisted and faulted. Some of the sections in the road cuttings between the Comstock mine and the township of Mount Zeehan show these features beautifully. The disturbing cause is seen in the presence throughout the field, in various places, of a volcanic rock which has been intruded through the slates and sandstones. Wherever I have seen this rock as yet it has been so thoroughly weathered as to have its original constitution quite obscured. It has been a felspathic rock without free quartz, and containing, probably, hornblende, so that it may have been a diorite or andesite. This rock is seen in great abundance on the road to the township, in the long hill leading down from the Comstock mine. Several dykes of it cross the road—one of them quite a quarter of a mile wide. In Balstrup's Section (1209M) and in Section 193-87 of the Argent Company it is seen again, also in the Silver Spray ground, Section 196-87, and some others. The presence of these igneous rocks may generally be detected on the surface by the unctuous reddish or brownish clay into which they decompose, which differs from the ordinary yellow clay of the district, in its being very free from sand. As being indications of former plutonic activity in the district, these rocks may be looked upon as favourable for the formation of mineral lodes, their intrusion having, doubtless, caused numerous fissures in the country rock, and been accompanied by hot springs and other thermal phenomena. Whether or not they are all dykes, or whether they have formed tuffs and lava flows, I cannot yet say. As the field is opened up their relations to the surrounding rocks will become manifest. It is quite likely that they may cut off, overlie, deviate, and otherwise affect the lodes in the adjoining slates and sandstones; so that every fact as to their influence for good or for evil upon these should be noted with great care by the miner.

On the road from Trial Harbour to Mount Zeehan another igneous formation is found for about two and a-half miles just before reaching the Comstock mine. This is a serpentine, especially on the eastern side of the formation, the western portion being more of an ordinary greenstone type and merging gradually into the serpentine. It is worthy of note that serpentine is also largely developed in the Heazlewood district, where, too, we find igneous decomposed rocks similar to those above mentioned. At the new Mount Dundas field, the same rocks are again found, namely, sandstone and slates, volcanic tufas, and serpentine. There is probably more than a mere coincidence in the fact of our three silver-lead fields having a somewhat similar geological structure. The coincidence extends even further than the country rocks, for

there is a general resemblance between Balstrup's lode at Mount Zeehan, Bell's and Godkin's lode at Heazlewood, and Webster and Bennett's lode at Mount Dundas, but especially between the two former.

The topography of the Mount Zeehan field is worth taking notice of, as it determines the nature of the mining operations, making it at once clear that the majority of the lodes must be worked from shafts and not from adits, and, in consequence, that winding and pumping machinery are necessary. Though the country is a good deal broken on the surface into hills and hollows, it is on the whole rather flat, and it is difficult to get any extent of "backs" on the lodes by means of adits. Many of the small hills, also, are of much disturbed rock—broken, slipped, and otherwise affected by movements of the surface portions. In these broken hills the lodes are not found to rise above the solid portion of the rock, and on driving into them along the lodes no height of backs can be obtained. This feature is very noticeable in the lodes known as Grubb's and M'Clean's. A consequence of it is that most of the outcrops have been found in low-lying ground, where the solid rock is close to the surface. Particular attention should therefore be devoted to the structure of the hills by the miner, as if they are of solid rock the lodes will probably rise into them, while if the rock is disturbed and broken they will most likely not rise.

The flatness of the country renders it swampy in wet weather, and as there is a somewhat large rainfall a great deal of surface water soon accumulates. The water-courses do not appear to carry off a great deal of water, and it seems certain that a good deal of the rainfall finds its way down into the rock, the high inclination of the strata favouring its doing so. The "Silver Queen" and "Mount Zeehan" mines find their pumps fully employed to keep down the water. I expect that other mines also will find that they will require rather powerful pumps.

The difficulty of prospecting the majority of the mines lies in this need of machinery for draining them, and the delay in opening them and getting out ore is mostly due to the same cause. The cost of landing machinery on the field is at present very great, the carriage from Hobart coming to £7 to £8 a ton, and owners naturally prefer waiting for the completion of the railway in order to reduce this prohibitive charge. But in the mean time a great deal of valuable prospecting could be done by means of the diamond drill. The lodes could be proved by this without difficulty to a depth of two or three hundred feet at least. The information gained by the borings would be of great assistance in laying out the permanent shafts afterwards, as the amount of underlay could be determined for some depth, whereas it can only be roughly guessed at from the short portion of the lode exposed in a shallow surface pit. I would strongly recommend the use of the drill in the present state of the field. It would soon settle the question as to the lodes continuing in depth.

There is a very common popular notion that requires to be eradicated, namely, that the ore raised from the mines is fit at once for the smelters. Such is not the case at all. By carefully selecting the best ore it is not difficult to get large quantities of galena requiring no further dressing, and the ease with which so much pure ore can be obtained is one of the most impressive facts in favour of Mount Zeehan as a most valuable and rich mineral field; yet the quantity of ore that requires dressing before going to the furnace is far in excess of that found pure. This is the case in every lead mine, and is only to be expected here. The bulk of the lode stuff is no more fit to go into the furnace without concentration than the crude tin ore from any of our tin mines. Lead ores ought to be concentrated and freed from gangue before smelting quite as much as tin ores. Though this is spoken of as a silver field it must be borne in mind that so far as quantity is concerned the mines are of lead, and that the metallurgical treatment is primarily for lead. In saving the lead we save the silver, and, conversely, if we throw away the lead by rejecting poor ore we are at the same time throwing away silver. Concentration works will therefore have to be provided for every mine of any magnitude, and the designing and construction of these should be the subject of most anxious care on the part of the owners, as on them the success of their operations will mainly depend. Expense should not be spared to make them thoroughly efficient, for a penny-wise policy in this respect can only end in disaster. In choosing a site for dressing works the main considerations are a plentiful supply of water and such an amount of fall in the ground as will permit the ore to fall from machine to machine without handling. The designing and erection of the works should not be entrusted to anyone but a man thoroughly skilled in this particular work, and it will be economy to procure such a man at any price. So many mines have failed through mistakes in the selection and erection of dressing machinery that the utmost care ought to be exercised by all owners to protect themselves in this most important part of their operations from the possibility of failure.

As winding, pumping, and ore-dressing machinery will be required to work all the mines on this field, it follows that a large amount of capital will have to be sunk before there is any possibility of a return. I do not think that shareholders sufficiently recognise this, or realise the magnitude of the task they have undertaken of bringing these mines to a paying condition. That they will pay well if rightly handled I have no doubt, but without the aid of foreign capital I fear that the resources of the Colony will not be enough to develope them. It is to our interest to meet foreign investors in a thoroughly liberal spirit. It is unfortunate that the capitalist rarely has a chance of taking up a mine for himself, but has to deal with speculators who have got hold of it only to sell at the highest figure they can extort. The holding of land for speculative purposes is a violation of the principle of the contract under which the State surrenders the national property in the mines to individuals on condition that they will make use of the gift. If they are not prepared to do so they ought to be made to give way to others who will. The speculative holder is one of the worst obstacles to the progress of the mining industry, for he blocks the genuine investor at every step.

I shall now proceed with a few remarks on the properties visited by me. As above stated, I was not able to visit all the mines, and it may be that some of those not mentioned by me may prove of greater importance than some of those visited. The account given below will, however, give a fair idea of the progress that has been made.

Silver Queen, (Sections 1666M, 1636M, 1637M, 1638M, 1639M, 1640M, 1641M, 1642M, 1643M, 1665M, in all 520 acres).—This mine has been energetically worked in spite of all obstacles, and now possesses winding and pumping machinery which has enabled work on the lodes to be carried on down to a depth of 105 feet. The principal workings are in section 1637. Here the main shaft has been sunk and also an air-shaft. Drives have been put in eastward and westward from the shaft. In the western drive, 275 feet in length, two lodes have been cut, and at the time I saw it there was in the face an undefined mass of iron pyrites, blende, and galena, which is probably part of a lode. The first lode cut, at 179 feet from the shaft, was rather small, and showed not much galena, but has not been driven on for any distance. The second lode, which is parallel to the first, was struck 95½ feet further westward. The lode was here from four to six feet in width, and consisted mostly of carbonate of iron, barytes, and galena, the latter forming a main vein which varied from two or three inches in width to as many feet, and several smaller veins. The air-shaft was sunk on this lode, and an excellent heap of ore was obtained from it. The course of these lodes is about 15 deg. to the E. of N. The eastern drive was in about 95 feet. A leader from four to six inches thick was cut in this, containing quartz, carbonate of iron, galena, blende, and iron pyrites, arranged in parallel bands symmetrically repeated from each side. The other lodes also show banded structure very plainly. As this type of structure is most characteristic of true fissure-lodes, it speaks well for the probable life of the lodes in depth. The eastern drive is being continued to cut another lode which crops out in the creek three or four chains to the north of the shaft. This outcrop shows good galena. On surface near the shaft the company owning this mine has built a number of houses for its employés and cleared some acres of bush, and also made a road and a tramway. In the large extent of ground held by it several other lodes have been found, on which no work has yet been done except some surface trenching. There are said to be as many as twelve lodes known in this property. The three lodes of the Montana Company (section 2154-87M) pass into section 1637 of the Silver Queen. In section 1666 a lode from 18 in. to two feet thick is found striking 15° E. of S., and with a dip to the eastward. The vein is composed of galena and carbonate of iron. A good deal of clean ore was obtained from this outcrop and sent away for sale. This is a very promising lode. It extends into sections 197-87 and 198-87 of the Silver Crown Company. Another lode is found in section 1643, close to the boundary of the Argent Company. Its course is 22° W. of S. It is about 24 inches wide, and is composed of quartz, iron oxide, pyrites, and galena. A lode bearing N. 7° E. has been cut on section 1637, supposed to be one of the Montana lodes. It shows some nice veins of galena. Other lodes have also been found. There can be no doubt that this company holds a valuable property, though it is questionable if it can work the whole of its large area by itself.

Montana, (Section 2154-87M, 40 acres).—This Company's ground has three lodes passing through it. The main workings are close to the eastern boundary. Here the lode shows splendid galena in a vein about eighteen inches to two feet thick. A nice stack of first-class ore had already been obtained from here, though the lode was only found about ten days before I saw it. This property should be a good one from present appearances, but requires pumping machinery to allow the lodes to be sunk upon.

Silver Crown, (Sections 197-87, 198-87, 199-87, 201-87, 736-87).—The two more easterly lodes of the Montana are supposed to unite in Section 736-87. The lode has been cut in a small shaft on the south boundary of this section. Some six tons of galena from this shaft were sent to Germany to be smelted, and yielded 114 oz. of silver to the ton. This shaft is on high ground, and a level is being driven from an adjacent gully to cut the lode about 90 feet below it. The drive was in 150 feet, and had 90 feet more to go, on 13th March. As the lode has in this case been cut in the high ground, the owners will be able to work some 90 feet in height of it without machine drainage. As above mentioned, the north-westerly lode found in Section 1666 of the Silver Queen passes into the Silver Crown ground, where it has been traced by means of trenches for some ten chains.

Western, (Sections 754-87, 755-87, and 756-87).—This Company has been working vigorously, and has in this respect shown a good example to many of its neighbours. Two parallel lodes, running N. 20° W., have been cut on the surface in Section 755. Two adits have been driven to cut them. The upper adit is 307 feet in length. At 118 feet from the mouth No. 2 lode was cut, about three feet in width, and carrying strings of galena from 3 in. to 6 in. wide. This lode has been driven on to the northward 45 feet. There are 28 feet of backs from the level to the surface. Ten tons from this lode gave a return of 75 per cent. of lead and 176 ounces of silver to the ton. At 287 feet No. 1 lode was cut, and has been driven on to the northward for 104 feet. It is from 4 inches to 9 inches wide. In the end of the drive it is now rather pinched and in hard slate country. Twelve tons of ore from No. 1 lode yielded 70 per cent. of lead and 102 ounces of silver to the ton. The mine manager told me he had about 22 tons of ore at grass from No. 1 lode, and 70 tons from No. 2 lode. The stacks showed very pure ore. The lower tunnel is from 40 to 45 feet below the upper one, and was in 278 feet on 13th March. At 79 feet from the mouth No. 3 lode was cut, running about N. and S., and showing from 12 to 18 inches of galena. This lode has been driven upon 150 feet, and shows well throughout. Eight tons of ore from it gave 61 per cent. of lead and 98 ounces of silver to the ton. It is estimated that this lower adit will cut No. 1 lode at about 475 feet, and No. 2 lode at from 655 to 680 feet. The country rock in the lower tunnel is slate and sandstone. In the upper one it is weathered slate from the mouth to No. 2 lode, and between No. 1 and No. 2 lodes it is a decomposed volcanic rock, charged with pyrites in places. This is no doubt a dyke, possibly of diorite, but the rock is so decomposed as to be impossible to be exactly named. From No. 1 lode to the end of No. 1 adit slate is again found. A fourth lode has also been found in this Company's ground in Sections 754 and 756. It is from 9 inches to 12 inches wide, and is composed mainly of carbonate of iron with a little galena; course 25° W. of N. It will be seen from the above that this Company, like the Silver Crown, is able to work to a depth of about 75 feet by means of adits, and thus will be able to get out a great deal of ore without much expense. The results of treatment of the ore so far are remarkably good.

Junction, (Section 819-87.)—This Company also holds Section 818-87, but as yet nothing has been

found on it. Near the southern boundary a lode showing from 12 in. to 18 in. of galena has been driven on for about 12 feet; course, N. 55° W., dip to N.E., rather flat. A small stack of good ore has been obtained from this lode. In the southern end of the trench leading to the drive the lode is split into several strings. In the N.E. corner of the property a vein running 7° W. of N., and showing 3 in. to 6 in. of solid clean galena, has been laid bare in a trench. If this vein continues it will pass into the Western and Montana properties. About 3 chains from the north and 4 chains from the east boundary a strong lode, two feet wide, striking N. 20° E., and dipping easterly, has also been found by trenching, but as yet has not been worked. The gangue here is quartz. A great deal more work must be done on these lodes before it is possible to form a just estimate of the value of this property.

F. R. Evans' Section, 1110-87.—About half a chain south of the Junction Section a lode running N. 20° W. has been cut in a surface trench, and some good ore was obtained. An adit has been driven about 200 feet to cut this lode lower down, but has been stopped without striking it. The country rock in the mouth of this adit is slate and sandstone, with strike N. 70° W. and dip N.E. 65°. About half way in a dyke is struck. This is soft and clayey, but belongs to the same series of intrusive rocks as the dyke above mentioned as occurring in the Western ground, with which it is probably connected. The adit should be extended through this dyke, and well into the slate on the other side of it.

Mount Zeehan, (Sections 559M and 909M).—This mine and the Silver Queen are the only ones yet regularly at work below the water level. The main shaft is 136 ft. 6 in. deep; and at 120 feet drives have been put in to the east and to the west. The eastern drive is 141 feet long, and cuts what is known as No. 3 lode at 113 feet. On this a drive has been made 24 feet northerly, and another 12 feet southerly. The lode is strong and well defined, but not rich in galena so far. I have already pointed out that this is no reason for undervaluing the mine, as poor places must exist, or even predominate, in every lode. The western drive is 252 ft. 6 in. long, and at 232 ft. 6 in. cuts No. 2 lode at the point where an air-shaft, now being sunk on it, will come in. This air-shaft was down 90 feet. The lode showed ore in greater or less quantities all the way down. In the bottom it was from 18 inches to 3 feet wide, and showed galena, carbonate of iron, and blende. This lode runs about 17° E. of N. On the surface it has been traced for six or seven chains, showing good ore. Another lode, known as No. 1, running N. 40° E., comes into No. 2 lode just at the air-shaft, and appears to be a branch of it, though it is quite possible that these lodes may fault one another. The relation of the north-eastern lodes to those running a north-westerly course has yet to be determined throughout the field. This No. 1 lode has been traced for 13 chains on surface. It is small, and winds about a good deal. About 90 feet south of the air-shaft a shaft 36 feet deep has been sunk on No. 2 lode. Here the lode was 5 feet wide, composed mainly of carbonate of iron and barytes, with veins of galena and some blende running through the veinstone. About a chain further south there is a strong outcrop, from which a ton of galena was taken to be sent to the London Mineral Exhibition. The lode is here about 2 feet wide. It appears on surface as a hard gossan with a little galena in it. About this place one of the Silver Queen lodes, which is found running N.W. through the N.E. corner of Section 909, ought to join or cross No. 2 lode. It may be called No. 5 lode. No. 4 is a small lode about 1 foot wide, striking N. 32° W., found crossing the main road about 3 chains to the east of No. 1 lode. Nothing has been done on it as yet, but it shows fair galena in the road cutting. No. 6 lode is found in Section 909, running a north-westerly course. It is better traced in the adjoining Section 943M. About 2½ chains to the eastward of No. 4 lode, and, like it, exposed by the road cutting, is a lode (No. 7) striking north and south, 18 in. to 20 in. wide, composed of gossan, lode-slate, and galena. No work is yet done on this. Yet another lode, No. 8, is found in Section 909, 5 chains S.W. from the N.E. corner. This lode strikes 25° W. of N., and is 18 in. wide, carrying a good deal of galena. It will be seen that this property has an unusual number of lodes running through it for its size. When they are opened up there should be good supplies of payable ore obtainable from them. The prospect for this Company is very good.

J. Smith's Section, 943M.—This ground lies to the south of that last mentioned. Surface trenching has revealed a lode from 3 in. to 18 in. wide, running 25° W. of N. from this section into Section 909, as above mentioned. The lode has been traced for 7 chains. A small shaft sunk on it yielded galena, said to assay over 100 ozs. of silver to the ton. About 2½ chains S.W. from this lode a tunnel has been driven on an irregular vein of ore for about 60 feet. In the mouth of the tunnel the vein strikes S. 47° E., and is composed of from 12 in. to 18 in. of gossan. At about 40 feet from the mouth of the drive the vein turns off to N. 42° E., and dips S.E. about 45°. The ground here gets hard, and the vein pinches to 3 in. in width.

Argent, (Sections 192-87M and 193-87M.)—Section 192-87 ought to prove a very valuable one, having no less than five lodes running through it. Of these, Nos. 1, 2, 4, and 5 belong to the north-easterly group of lodes, while No. 3 runs north-westerly. Nos. 1 and 5 are not improbably Nos. 2 and 3 of the Mount Zeehan Company's lodes, and No. 4 is also in the Silver Queen Extended's ground. The Argent Company has been busy for some time past with the erection of winding and pumping machinery to enable sinking to be proceeded with. Good progress has been made with this work. In conjunction with the Silver Queen Extended Company a tramway has been made in a substantial manner from the mines to the township. This will be of great service to both companies. The principal workings are on No. 4 lode. This strikes N. 30° E., and underlays easterly one foot in three. On the surface it crops out strongly, showing galena and gossan. It extends right through the section into section 909 on the north and into 1209M (Balstrup's) on the south, and is a strong, good-looking lode. The main shaft has been sunk 100 ft. to the eastward of it. About 2½ chains S.W. from this shaft No. 3 lode is found cropping out. This has a course N. 25° W., and is a strong banded lode from two to six feet wide, of galena, pyrites, siderite, baryte, blende, and quartz. It has been traced for 14 chains from where it runs into No. 4. Though this lode has only been bared in surface trenches, I liked its appearance better than that of most of the others, and should expect it to prove a most permanent lode. It is much more likely to be heaved by No. 4 lode than to

junction with it, and its continuation on the western side of the section should be searched for. No. 2 lode is not of much consequence as yet, and consists of outcrops of gossan and pyrites. The manager of the mine believes that it junctions with No. 3. The No. 1 lode has been traced for eight chains. It strikes N. 15° E., and underlays easterly. On the outcrop it shows good galena. One hundred and fifty-two bags of ore from this lode and No. 4 yielded 65 per cent. of lead and 92 ounces of silver to the ton, according to the mine manager. Only one trench has been cut on No. 5 lode. Its course is somewhat to the east of north, and it shows a little galena and copper pyrites. In section 193-87 an adit about 200 feet long has been driven in an easterly direction. The mouth of the tunnel is in volcanic rock resembling tufa, but I could not clearly ascertain whether it was a tufa or a decomposed dyke. We meet igneous rocks again in Balstrup's section to the south of this, and again in the Silver Spray ground. The Argent Company has a property that ought to pay well when opened up.

Balstrup's, (Section 1209M).—The No. 4 Argent lode is seen in this section in a trench 25 feet from the northern boundary, striking N. 10° E. It shows as 30 inches in width of gossan, containing a little carbonate of lead. The gossan is said to have given assays of 66 and 180 ounces of silver to the ton. The main workings on this section are not on this lode, however, but on one of quite different character from any of those above mentioned. The lode strikes S. 40° E., and appears as from 18 in. to 30 in. or more of quartz containing brown oxide of iron, clay, oxide of manganese, pyromorphite, pyrites, and, in places, chloride of silver. An adit has been driven on the course of the lode close on 1000 feet, but at 300 feet from the mouth it bears away towards the south and leaves the lode. I cannot understand the reason of this change of course of the drive. The last 120 feet of it is driven in hard slate strongly jointed. The first portion is in decomposed igneous rock. The contact of the slate and igneous rock is hard bricklike brown slate, as if altered by heat, and from this and other considerations I take the igneous rock to be a large dyke. The adit is driven under a high hill, the top of which is capped by an immense body of gossan, composed of oxides of iron and manganese. This is said to give on assay from one to ten ounces of silver to the ton. The gossan extends along the ridge of the hill in a north-easterly direction for a great distance. It would be a most useful flux for smelting siliceous ores. I think it is a pity that an adit was not driven about 50 feet below the outcrop of the gossan to prove its continuance in depth before the long low-level adit was undertaken. An outcrop of gossan does not necessarily prove the existence of a lode beneath it, and quite a small lode also may have a very large gossan upon it. Where any ferruginous rock has suffered decomposition, we may expect to find gossans in favourable situations, and it is quite possible that the gossan in question is derived from the dyke beneath it, and not from a lode. Hence the advisability of proving the presence of a lode by a shallow adit just below the gossan capping. Where veinstone, such as quartz, baryte, and calcite, and such vein minerals as carbonate, sulphate, and phosphate of lead, or green and blue carbonates of copper, are found freely throughout the gossan, there is almost a certainty of its being the cap of a lode; but a gossan such as is found here, almost entirely made up of oxides of iron and manganese, may result from other causes than the weathering of lode matter.

The siliceous vein on which the adit has been driven is reported to have yielded rich ore. Such being the case, it is a marvel to me why the owners have not done more to prove it and develope it. The ironstone deposit will be most useful when furnaces are erected in the district for smelting, especially as it contains a little silver.

Silver Queen Extended, (Sections 187-87, 188-87, and 189-87).—I must preface my remarks on this property by saying that I only saw portion of it, and on the appended map of the district I have not attempted to sketch those lodes that I did see, as I was unable to ascertain even their approximate position. Eight or more lodes have been discovered in the property, and I was informed that there was good reason to hope that some of those last found in the western sections could be worked by means of adits to some depth. In Section 189-87 good progress has been made with preparations for the erection of winding and drainage engines, the brace being already erected. Five or six lodes, of widths from a few inches to two and three feet, have been laid bare by trenching. Some of these show very good veins of galena. From one, a little to the south of the manager's house, some excellent pure ore was taken for exhibition. Without describing the veins or lodes in detail, I may say that my rather hurried look over this property gave me a most favourable impression, its lodes being both numerous and showing quantities of rich ore. When the surface is still further stripped from these lodes they should make a fine show. This eastern section must be worked from shafts furnished with good pumps.

Silver Spray, (Sections 195-87 and 196-87).—This ground is immediately south of the last described. A good deal of work has been done, but unfortunately without much success as yet. A lode carrying some galena was cut on surface, running N. 32° W., and underlaying 1 in 6 to the north-east. A drive 265 feet long was put in along this lode. The average width of the lode formation is 3 feet, and it has a fine well-marked footwall. A blank in the lode appears to have been met with, for the channel is filled with fragments of slate and "mullock," with only stray pieces of galena through it. On the surface the lode showed gossan with some pyrites and galena, and its outcrop has been traced uphill for 5½ chains, or to a height of 210 feet above the adit. This lode appears to rise with the hill, and if anything of value is found in it will therefore be easily worked for a time without machine drainage. The drive on the course of the lode should be carried on in the hope of coming to ore and solid veinstone. The country passed through is slate, divided by joints into large blocks, and much disturbed, vertically and horizontally bedded slates being found within a few feet of each other. About 130 feet from the mouth of the adit a branch drive to the right strikes a gossan lode about 3 feet thick, but pinched in the end of the drive to from 9 in. to 12 in. This lode strikes N. 25° W., and underlays westward, so that it will meet the first lode in depth. The lodes are about 25 feet apart. The drive on this second lode is 65 feet long, about 30 feet being on the course of the lode. So far the gossan has been poor in silver. Near the end of the drive on No. 1 lode a crosscut has been driven 46 feet to the left without cutting any more lodes; but another one, 86 feet to the right, has been more successful, cutting another gossan lode (No. 3) at 68 feet. This strikes N. 65° E., is about 30 inches wide, and contains a little silver and a trace of gold, but nothing payable.

Two gossan formations or outcrops on this property have attracted attention. One of these is 12 feet or more wide, and has been traced by trenches and outcrops for five chains on a course N. 80° E. The other is about four chains to the east of this, and runs about north and south. Both of these gossans carry a little silver, from 3 to 7 ounces to the ton. To cut the first of these an adit has been driven 260 feet at not more than about 40 feet below the outcrop. The drive is 150 feet past the line of the outcrop on the surface, but has not cut a lode, unless a small vein 2 inches to 3 inches wide, cut just under the surface outcrop, can be so regarded. This drive is entirely through volcanic tufas and breccias, enclosing numerous angular fragments of slate. A few quartz veins are cut in the drive. The experience of this Company in driving under a gossan outcrop ought to be attentively studied by the owners of Balstrup's and other mines, where faith has been reposed on similar formations of iron and manganese oxides.

Grubb's Lode, (1562–87 and 1580–87 Sections).—The workings on this lode are situated about the middle of Section 1562-87, close to the creek. Two adits have been driven, one on each side of the creek. The south one is on the course of the lode, and is in 260 feet. At 200 feet the lode dipped under foot, this being one of the cases where the lode has not been found to rise into the hill into which the drive has been put. The country is broken and weathered slate. In the drive the lode has ranged from 18 inches to 7 feet in width, and in parts has been all galena. About 70 tons have been exported from here, and there is a large stack of second-rate ore still on the ground. This contains a good deal of baryte, pyrites, and other gangue along with the galena. This is a fine strong lode so far as it is exposed, but pumps will have to be used to drain the workings on it. On the north side of the creek a tunnel has been put in 300 feet through soft yellow clayey slate, but the last 10 feet in hardish black slate. A lode of galena 12 inches to 18 inches wide was cut in this 25 feet sooner than the lode was expected, but it appears to be the lode, as further driving has not cut anything more. The country rock is much stained with carbonates of copper. The owners of this property will have to sink before they can prove it. The diamond drill would be useful here.

Silver Duke, (Sections 1833-87, 1679-87, 1706-87, 1677-87, and 1678-87).—The southern continuation of Grubb's lode is expected to be found in Section 1679-87, and a drive has been made to cut it, but without success. The diamond drill would be useful in tracing the lode here, as the surface ground appears to be much disturbed, and the lode probably does not rise into it, so that a drive might easily pass over the lode. About 12 chains from the western boundary of the same section a somewhat peculiar galena deposit has been met with. An upper drive, 52 feet long, and a lower one, 152 feet long, have been driven on the course of the deposit, which strikes about S. 70° E., but appears to be turning more to the northward in the end of the lower drive. The deposit is as much as 40 feet wide in parts, and is composed of broken blocks of slate, sandstone, and grit loosely cemented together with cellular quartz and carbonate of iron, and containing scattered through the interstices between the lumps of stone cellular lumps of galena and mixtures of galena, blende, iron pyrites, and copper pyrites, with carbonate of iron and clayey matter. Green stains of carbonate of copper are rather plentiful. There is a good deal of galena throughout the mass, and it is quite possible that there is enough of it to be payable. But the occurrence is so irregular that no reliance can be placed on the continuance of the ore either in strike or under foot. It appears to me that the deposit results from a fracture in the rocks, possibly a fault fissure, being loosely filled with broken country matter, and then impregnated with metallic minerals from solutions travelling through this. The shape and appearance of the lumps of galena forcibly recall those of the segregated pieces of pyrites found throughout the black mudstone bottom underlying the Mount Lyell alluvial gravels above described. In these too, similar galena has been found. The quartz also has a cellular and granular character similar to that often found in clays, drifts, and faults. If my theory of the formation of this deposit is correct, it will not be safe to rely on its following the usual behaviour of true lodes. It may extend for a good distance both in strike and in depth, but the distribution of ore in it is likely to be very uneven. There is enough ore in it to make it worth exploring as long as this can be done at a low cost, but the prospect seems to me to be too doubtful to make it advisable to go to large expense in sinking on it. Perhaps as the drive is extended the deposit may take a more defined lode character, and in that case sinking would be advisable. This is one of the occurrences where we may state possibilities, but where every fact must be developed at the point of the pick.

In Section 1677-87, several small shafts and trenches have been sunk on what is known as M'Clean's lode, which has been traced south into this ground. The lode appears to be very small here, but shows galena, and has been traced for a long distance. As this is one of the longest and most promising lodes on the field, it would be well to prove it on the Silver Duke ground to some depth by boring, in the hope that it may widen out below. Testing the lode by sinking on it will involve the expense of pumping-engines.

Tasmanian Silver Mining Company, (Sections 1468-87, 1467-87, 1469-87, 1688-87, and 1470-87).—These sections are taken up along the line of what is generally known as M'Clean's lode. In Section 1469-87, a drive on the course of the lode has been put in 210 feet, but at 120 feet broken country was encountered and the lode was not found to rise into this, behaving in this respect like Grubb's lode. The lode is a fine strong one, and has shown at times as much as 5 feet in width of pure galena, whilst generally there is from 18 inches to 3 feet of galena in it. Course N. 33° W. On M'Clean's Creek, on Section 1468, the lode has been struck, carrying quartz and galena. It has also been found in Section 1467, about the middle of the section, and in 1470 about 3 chains from the south boundary. In the N.W. corner of Section 1470 it is again found as about 3 feet in width of lodeslate quartz and galena. The lode has therefore been traced throughout this property and into the Silver Duke ground on the south, a distance of close on two miles. As it shows a good deal of galena throughout, and has been rich where driven upon in the tunnel, there is no doubt as to its importance. It may reasonably be expected to prove one of the best lodes in the field. Like so many others, it will require machinery to drain it, adit drainage not being available. Another lode parallel to the main one has been cut in Section 1470, about four chains east of it. A shaft has been sunk on this No. 2 lode to a depth of 25 feet. It is about 18 inches wide, and carries blende, galena, and pyrites. As this lode underlays to the westward, while No. 1 underlays to the eastward, they should unite in depth somewhere about 500 feet from surface.

I noticed another outcrop of the igneous rock on the west side of No. 1 lode, about 8 chains from it, on section 1470.

South Comstock, (Section 803-87).—Close to the north boundary of this section a drive has been put in on a lode of mixed pyrites and blende, with a little galena. There was no one working here, so that I got no further information as to what had been done.

Comstock, (Section 712-87).—A fine lode is laid bare in a long deep surface trench along its course in this property. I was told that some 300 tons of ore had been raised from here, and exported at a good profit. A large stack of ore is still on the ground. The lode strikes N. 2° W. in the trench, and has a very slight underlay to the east. The lode is from 3 to 5 feet wide, and is a banded lode; the contents—galena, blende, iron pyrites, and copper pyrites, with gangue of quartz, siderite, and baryte—being arranged in layers parallel to the walls. This is one of the most characteristic features of galena and blende lodes in other parts of the world, and is a very favourable indication of permanence. The lode has been traced on surface for quite 10 chains, and is well defined throughout. I feel confident that it will prove a good lode, though the complex ore in it will necessitate elaborate dressing. This lode is one of the highest in the Zeehan field, and adit drainage to some depth is practicable. An adit is being driven from the creek in the South Comstock ground through hard contorted slate to cut the lode on the boundary between Sections 712 and 803. It was in about 200 feet when I saw it, and had to go in all about 450 feet. When this adit is finished there will be about 100 feet of backs ready to be taken out along the lode. Another small lode running N. 5° W. has been cut in a surface trench about 8 chains from the eastern boundary line. This shows galena and pyrites, but the trench has been partly filled, and I could not see much of this lode. The property on the whole seems to me a very good one, and has several advantages over its neighbours, such as the possession of a good water supply and the possibility of adit drainage, that will compensate for the possibly greater difficulty of rendering the ore fit for smelting.

Silver King, (Sections 217-87, 219-87, 220-87, 469-87, 223-87, 218-87, 468-87, 221-87, 222-87, and 470-87).—The main lode passing through this property has been traced for over 2 miles, from the Sunrise Prospecting Association's ground on the south to the Despatch Company's (Section 243-87) on the north, while the lode in the S.W. corner of 841-87 may also be part of it. On Section 223-87 the company is erecting winding and pumping-engines, and sinking a main shaft. These works are close to the terminus of the railway. Two small shafts, about 30 feet apart, have been sunk on the outcrop of the lode, and from these and surface trenches about 130 tons of ore have been got out and stacked. This ore contains blende and siderite in addition to galena, and would be the better of dressing before smelting. The outcrop is about 3 feet in width, striking N. 30° W., and underlaying westerly 1 in 3½. In Section 470-87 the lode is cut just on the southern boundary. A drive on its course is being put in, and some good ore has been obtained. No height of backs is, however, obtainable without sinking. Another lode parallel to the main one is found 12 chains S.E. from the main shaft in Section 469. Here a small shaft was sunk on it 40 feet, but was soon flooded. The lode on the surface is 18 inches wide, and contains very good galena. Embolite is said to have been found in some of the ore from this lode. The main lode is again cut in the northernmost section of the property, here, too, containing a good show of galena. This company should have a bright future before it, the prospects being very good.

Silver Bell, (Section 480-87.)—This company is working on part of the Silver King lode, and has made a remarkably good show of ore. About half a chain from the northern boundary a shaft, 40 feet deep, has been sunk on the lode, and about 10 chains further south another, 43 feet deep, has been put down. From the latter drives to the north, 37 feet, and to the south, 20 feet, have been made. From these workings a splendid stack of first-class ore has been secured. Some five or six chains further south an adit has been driven on the course of the lode to the northward at as low a level as could well be got, but this is only sufficient to give 43 feet of backs at the highest point in the lode. The drive has been in splendid ore from the first, the lode being from 30 inches to 4 or 5 feet in thickness, and often almost pure galena. It is well defined, and with a good clear footwall. The manager informed me that he had about 250 tons of first-rate ore on hand, and about 200 tons of second-class stuff. If the lode continues in the level as well as it has been this company should have no difficulty in paying for the sinking machinery out of the ore raised. The lode looks well all along the surface, so that there is every reason for the owners to congratulate themselves on the prospects of the mine.

Bell and Hall's, (Sections 419-87, 422-87, 421-87, and 420-87.)—This ground is quite undeveloped, but has a very promising looking gossan outcrop upon it carrying carbonate of lead, galena, blende, calcite, siderite, quartz, and other lode minerals. Embolite crystals are said to have been found on it. There can be no doubt that this is the outcrop of a lode. It strikes to the N.W., and following on this line about 8 chains we come to another outcrop of gossan, also carrying carbonate of lead. The outcrop appears to be from 12 to 30 feet wide. The ground is very flat and low-lying, so that next to nothing can be done on the lode without sinking. So far as one can judge from a mere outcrop, this lode ought to be a good one. I do not think I have seen a more promising "surface show" in the district. It ought not to lie idle for long.

MOUNT DUNDAS DISTRICT.

Great hopes are entertained that the difficulties as to drainage met with at Mount Zeehan will not be encountered in this new field, and consequently that some of its mines may be opened up and put on the dividend-paying list without much preliminary expense. The rugged character of the country, its steep hills and deep gorges, make it very suitable for mining operations, while it has further advantages in the possession of a good water supply and fairly good timber. A very large number of claims have lately been pegged out on this field, which lies about four and a half miles to the eastward from Mount Zeehan township. A road is in course of construction from Mount Zeehan to it, which will prove a great benefit. Not much work has yet been done on the lodes discovered, which is not surprising considering that all supplies have as yet to be carried on men's backs to the claims. The small amount of

development makes it premature to form any decided opinion as to the future of the field, but the prospects are encouraging, and numerous further discoveries may reasonably be anticipated. Many of the present claims are taken up on outcrops of gossan, which may or may not turn out to be lodes. Time and work must decide. I visited only a few of the claims, but saw enough of the field to satisfy myself that a detailed examination of it twelve months hence would be quite soon enough to give an idea of its value. Till some work has been done to prove the lodes their prospects must be very much a matter of speculation.

Webster and Bennett's, (2305-87 and 2306-87).—These prospectors have taken up two 80-acre sections, not yet shown on the maps, on the line of a strong gossan outcrop, striking N. 20° W. As the outcrop can be distinctly traced in a definite line up hill and down dale for quite half a mile, there can be little question as to its belonging to a lode. The gossan is composed of limonite, hematite, oxides of manganese, quartz, and a little kaolin and pyrites. It is on an average from 15 to 20 feet wide, and assays are said to have given from 3 to 12 ounces of silver to the ton. The line of lode is intersected by two creeks from which adits may be driven on the course of the lode, proving it very easily. One adit has been begun, but so far is still in gossan. From 100 to 700 feet of backs can be got on different parts of the lode by adits from the creeks. As far as yet proved the lode has been worthless except for flux, but it is well worth prospecting in the hope of coming upon valuable ore. If such is found in it, the working facilities are so good that it should be a good mine. The hill to the south of the adit shows volcanic tufas and breccias in places. The country seen in the creeks is sandstone and slate.

Mellor's Section, 1724-87.—In this ground two outcrops of iron and manganese gossan have been found, both running about N.E. and S.W., but badly defined. I did not like the nature of either of these gossans, and think they ought to have been deeply trenched through or driven upon at a shallow level before trying to cut them at considerable depth, as is now being done. A tunnel is being driven to cut one of them at about 250 feet below the outcrop. This will have to go about 500 feet, and the 132 feet now driven have been through hard slate and sandstone country. A quartz reef which crops out on the hill-side should be cut by this adit before the lode supposed to underlie the gossan is met with. To test the other gossan outcrop a drive has been begun, which will reach the line of the surface deposit in about 150 feet, and will then be about 100 feet below the surface. The presence of serpentine rocks in close proximity to the eastern boundary of the section creates a suspicion that the iron ore may have come from them, in which case it would be a mere surface deposit. The work in progress will settle the question in time, but it would have been wiser to have driven a shallow level first. The ground is most favourable for such a course.

Lambie and Davies' Sections, (2298-87 and 2297-87).—These two prospectors have been more fortunate than the preceding in finding galena ore on the surface in three places. In the north part of 2297-87 a lode (No. 1) is cut alongside a creek. It strikes N. 35° W., and underlays N.E. about ½ to 1. It is composed of from six to ten inches of galena with crystals of cerussite (carbonate of lead) and baryte, and is exposed by a trench for about two chains. This lode lies almost in the bed of the creek, and cannot be worked by an adit at the place where it has been struck. In the south-east corner of the same section, about 8 chains from the southern and 4 chains from the eastern boundary is another lode (No. 2), which may perhaps prove identical with No. 1. Its course is N. 45° W., and the lode is from 24 inches to 30 inches wide where cut, and shows about 8 inches of galena. The gossan capping contains crystals of carbonate of lead. The lode is running right into a high hill, and a level driven along its course would have good backs above it. In the north-east corner of the same section, about 8 chains from the east, and 4 chains from the north boundary, is a very large outcrop, bared for quite 12 feet in width, and traced up-hill for quite a chain. It carries galena, gossan, and carbonate of lead. Its apparent course is about N.W. and S.E. This has every appearance of being a strong lode. A little to the south of it a branch lode, 4 feet wide, carrying galena and green pyromorphite, and running N. 10° W., is cut across on surface. These lodes can be splendidly tested by driving right into a big hill on their course. About a chain from the western boundary of the section there is a huge gossan outcrop, carrying chromate of lead. Nothing has been yet done on this, but it deserves to be prospected. The property has a very good prospect before it, and will be much heard of before long.

Page's Section.—Fine crystals of chromate of lead have been found in a gossan outcrop in a section whose number I could not identify. The outcrop is a large one, but nothing has been done to it beyond chipping off a few pounds of samples. I had heard so much about the splendid prospects of this lode that the reality was disappointing. "Indications" and talk do not make a mine, however good the one and tall the other; and a prospector finding a lode like this should do something to open it before presenting it to the public.

There is a considerable quantity of serpentine in parts of the Mount Dundas field,—some of it of very good colour. When the district is opened up it is very probable that serpentine fit for ornamental purposes will be found. So beautiful a stone ought not to lie neglected. Very pretty serpentine rocks are also found in the Heazlewood District, and are worthy of attention from lapidaries and architects.

MOUNT HEEMSKIRK DISTRICT.

From inquiries made at Zeehan and Trial Harbour, I ascertained that nothing of consequence was being done on this tin-field, and that it was almost, if not quite, deserted. It was therefore not visited on this occasion.

THE SPECIMEN REEF, HALL'S CREEK.

For a year or more past no work has been done in the mine on this reef, the energies of the owners being directed towards the erection of a battery and the construction of water-races, dams, and tramways. These are now finished, and crushing should begin as soon as there is water enough. Two levels have

been driven on the reef, and a winze has connected them, so that the ground is ready for stoping. Some extremely rich stone has been obtained from this mine,—the gold being mostly mixed with oxides of iron and manganese in black lumps, locally called "clinkers." Carbonate of iron and iron pyrites are somewhat common in the quartz. It has never been possible to give this reef a fair trial until now, for want of a battery. A few months' work in the mine will now afford a good test of the value of the portion open. There has been so much gold got in the surface portion of the mine that there is good hope of payable quartz continuing to be found below. The reef is small, but there are considerable natural facilities for sending the quartz to the battery, which will serve in some measure to make up for this. A tramway has been made from the mouth of the lower level to a shoot leading to the battery. This comprises six heads of stamps, driven by a 24-ft. water-wheel. After the ordinary copper tables, one of Alves's Amalgamators and Concentrators has been provided. As might be expected from the inaccessibility of the place, the battery is full of makeshifts,—a berdan liner, for example, serving for the entire berdan. Storage for tailings ought to be provided. The battery will do to test the stone for a time, but something much better will be required for regular work. Better modes of access to the claim are also urgently required, so that stores and tools may be taken to it in reasonable time and at reasonable cost. The owners propose to try to find a suitable line for a track directly through to the Heazlewood, which seems practicable enough, though the country is dreadfully broken by deep ravines,—that of the Savage River being the worst.

HEAZLEWOOD DISTRICT.

The geological features of this district are of great interest, and deserve a much closer examination than I was able to give them on this occasion. The central portion of the field is composed of silurian sandstones and limestones, and these are flanked on the western side by a wide belt of serpentine, and on the east by greenstones. The serpentine rock is a metamorphosed highly crystalline plutonic rock, in places inclining to gabbro, but requiring minute and extended microscopical and chemical examination to determine its original nature. Schiller-spar is somewhat common in it, and parts of the rock containing this mineral are very beautiful. Fine crystals of chromite occur plentifully in a creek running through the Heazlewood and South Heazlewood Companies' ground, evidently derived from the serpentine. It appears also to contain a good deal of nickel, as much of the veinstone in the Heazlewood lode is stained bright green by traces of nickel compounds, and the hydrated carbonate of nickel (zaratite) has been found in joints of the serpentine in sufficient quantity to induce hopes of its proving of commercial value. From an examination of the occurrence of this ore on Sections 2124-87 and 2125-87, I do not think that there is much chance of the ore being obtained in quantities sufficient to pay. It is found in joints of the serpentine, and nice specimens are readily obtained; but I saw no sign of a true lode of it, or any indication that it was present in workable quantity. The sections taken up for nickel are on the top of the high hill, north of the Heazlewood River from the Heazlewood Bridge.

There appear to be two main lines of lode in this district, one extending through the Heazlewood Extended, Heazlewood, and No. 1 South Heazlewood Companies' holdings, and the other traversing those of the Whyte River, Bell and Smith's, Godkin Extended, and Godkin Companies. Outside of these two main lines the only workings of consequence are those for gold, near the Castray River. Alluvial gold has been worked by sluicing, with fair results, in past years in several of the creeks running into the Whyte River. An old bed of the Castray River runs to the north-west through Sections 1937-87 and 1060-87. This has been sluiced with very good results up to a certain point, where it became poor. At this point prospecting has discovered the gold in its matrix, and the operations now in progress are to work this. It is a fine grained brown sandstone bed striking about N.N.W., and dipping easterly 30°. The bed is about 2½ feet thick, and lies between clayey beds. The gold is rounded and waterworn. A great deal of magnetic iron sand is with the gold when panned out from this stuff. Very good prospects are obtainable throughout the whole of the bed so far as it has been tried. I cannot yet say what is the geological age of this auriferous sandstone, not having made a sufficient examination of the neighbouring silurian rocks to determine its relation to them. A considerable extent of it has been proved auriferous, and it is well worth trying. The prospectors had a small hand-power battery, with which they crushed a few tons of sandstone, the yield being very good. I should recommend any company taking this ground in hand to make sure of having a sufficient amount of pay-dirt in sight before erecting crushing machinery, as from its nature the deposit may be expected to vary very much in quality. For crushing the stone I fancy a sort of puddling machine would be sufficient, or a Dodge Pulveriser. This last is a sort of iron churn, which rapidly disintegrates any soft rock like the sandstone in question. Such a machine would be much cheaper and do much more work than a stamping battery. A battery of light stamps running very fast, and with a short drop, would be much preferable to an ordinary quartz-mill for this sort of stuff. Great attention will have to be paid to the amalgamation of the gold, as loss will be liable to occur from its fineness, from its becoming coated with clay, from its being naturally coated with iron oxide, and from the turbidity of the water used, this last resulting from the amount of clay in the sandstone. Long blanket strakes, well attended to, will probably prove the most efficient gold-savers. The workings are on Section 74-88.

Heazlewood S.L. Mine, (Sections 1309M and 1310M).—The owners of this property have done a great deal of work in prospecting it on the surface and by means of shallow workings, with somewhat variable success. It has been demonstrated that a main lode extends in a north-north-westerly direction through both sections, and several small veins parallel to the main lode have also been discovered. On these latter no work to speak of has been done. In the southern section (1310M) the main workings are not far from the south boundary. A lode (known as No. 4) cut in the creek near this has a very promising-looking outcrop of galena and gossan, but has not yet been worked; course, N. 18° W. The main line of lode has two branches in this part of the holding, forming parallel lodes about 18 feet apart, running about N.N.W. through serpentine country. Between the two lodes the country is full of veins of calcite, and much infiltrated with lode matter, so that the two lodes may almost be considered to be one. A crosscut has been

driven across both lodes a distance of 141 feet altogether. On the course of No. 2 lode a drive has been made for 308 feet. The lode varies from a few inches to three or four feet in thickness of galena, blende, iron pyrites, calcite, calcedony, and quartz, but rarely shows more than two or three inches of pure galena. The lode has a beautifully banded structure. Some of the quartz and calcedony is coloured beautifully green with silicate of nickel. Though the workings have not yet reached payable quantities of ore in this part of the mine, the prospect is so encouraging that the drive should be vigorously carried on, as good bunches of ore may be cut at any time. In order to cut the lodes at greater depth a low-level tunnel was begun further down the creek than the workings just described, but was discontinued after being driven 160 feet.

On the northern section (1309M) the lode has been much richer in ore. Some hundreds of tons of ore have been taken out of it by means of shallow drives, shafts, and under-hand stopes. The lode is from 6 to 14 feet in width, and is well defined from the serpentine country enclosing it. The galena forms a vein in the lode from 2 to 3 inches wide as a rule, but now and then widening out into good bunches. A good deal of blende accompanies it. The bulk of the veinstone is altered country rock, carbonate of lime, and calcedony, all coloured green by silicate of nickel. A main shaft, 68 feet, and an air shaft, 70 feet deep, have been sunk on the lode, which is here vertical, and an adit (349 feet long) has been driven to the air-shaft. The manager proposes to drive a level about 110 feet below the bottom of the main shaft from a valley lying conveniently near the line of lode. This adit would cut the line of lode in about 100 feet, and would be directly under the ore body proved on surface in about 600 feet, so that besides prospecting a long piece of new ground it would give nearly 140 feet of backs on the portion of the lode known to contain ore. This most useful and necessary work should be pushed on. If the drive on the lode on the south section were continued to beneath the northern workings, the manager informed me that it would be about 1700 feet in length, and would be 310 feet below the surface. A better prospecting and developing work could hardly be devised. It would open the lode along its entire length, and cut any ore bodies existing in it, while at the same time draining it. In the present state of the tracks in the district no pumping machinery can be got on to the ground without constructing some four or five miles of road, and natural drainage of the mine is therefore of great consequence.

The appearance of this mine does not warrant me in predicting for it great future success, but it is decidedly too promising for the lode to be left alone. There is a very good chance of success, and whether it turns out well or badly in the end, I can only say at present that it is a legitimate mining venture.

No. 1, *Heazlewood, South,* (Sections 1619 and 1620M.)—In these sections the Heazlewood lode has been followed by surface trenches, but with poor success, only small ore veins being found. Some of the ore contains chromate of lead as well as carbonate and sulphide. Much deeper work must be done in this ground before it is clear that it possesses a payable lode. In Section 1937-87, on the Castray River, a vein of galena has been found, which is supposed to be portion of the Heazlewood lode. If the connection can be proved there is good hope of payable ore being found anywhere along the line of lode from the Castray River to the Heazlewood.

Heazlewood Extended, (Sections 4-87M and 825-87M.)—This company has done a lot of prospecting, and has found several lodes which are more or less promising. The Heazlewood main lode has been traced right through the ground and into Section 1596M, across the Heazlewood River. On surface it has as yet shown no quantity of good ore. To the westward from it there has been found a rather flat-lying lode, showing stains of blue and green carbonates of copper, and containing, it is said, both silver and gold. A tunnel has been driven 400 feet through serpentine country to cut this at a low level, but has not yet reached it. Another small prospecting tunnel, in about 60 feet, has cut some small veins containing chromate of lead. On the main lode a shaft has been sunk 40 feet, and a drive has been made across the lode, which is here 14 feet wide. The lode stuff is mostly calcite, containing very thin veins of galena, blende, and copper pyrites. To the eastward of the main lode a small lode carrying galena has been found, which should run into the main lode across the Heazlewood River. Where this is cut on surface the vein of galena is only about half an inch thick, but 73 feet lower down, where the lode is cut by an adit 250 feet long, there is about 3 inches of fine clean ore. A drive has been put along the course of the lode for 140 feet, the clean galena being from 2 to 4 inches thick throughout it. A nice heap of ore has been taken from this lode. A new tunnel has been started from the river to cut this lode, and should soon reach it. The deep valley of the Heazlewood is very favourably situated for working these lodes, as it cuts right across them, and it is therefore possible to drive in at once on the course of the lodes. This seems to me the best policy for this company to adopt, to prove their lodes by driving on them, cross-cutting at the same time at intervals. Something much better than is now visible must be got before any returns will come to the owners.

Whyte River Company, (Section 1083-87.)—The country rock in this section is entirely different from that which encloses the Heazlewood lodes, being a decomposed igneous rock, possibly diorite. Two adits have been driven through this, there being about 80 feet of vertical distance between them. The lower tunnel was in 110 feet when I saw it but had not reached the lode. A small vein was, however, cut near the entrance, showing blende, galena, and pyrites.

The upper tunnel was driven some time ago by a party prospecting for gold, in order to cut a quartz reef which is seen on the surface. At about 80 feet from the mouth they passed through what is now recognised as a lode without apparently noticing it, and went on for another 70 or 80 feet. The lode is from 5 to 6 feet wide, composed of broken country rock impregnated with chromate and carbonate of lead and oxide of antimony. This stuff is reported to give excellent assays for silver. At a greater depth the lode will probably contain more quartz and be better defined. It is similar in occurrence and appearance to the lodes in Bell's and Godkin's properties, and may be portion of the same lode.

W. R. Bell's Sections, (887-87M and 44-87M).—Immense quantities of gossan, carrying a little silver, are found in a line running about N.W. and S.E. from these sections down to the Whyte River. This has come to be called "Godkin's" line of lode, but ought to be known as "Bell's," as Bell's discovery was

prior to Godkin's. That the large outcrop of gossan covers an equally large lode I very much doubt, but the regularity of its strike over hill and valley, and the regular presence of more or less silver throughout it, point to its origin from a fissure of some sort. As work opens the deposit to view, its true nature will become clear; but at present I am inclined to believe that the gossan indicates the outcrop of an igneous dyke, of the same decomposed character as the rock found in the Whyte River Company's mine above mentioned, and that the lodes are formed in fissures in this dyke. In Bell's ground the dyke is clear, breaking through silurian limestone, which is found on both sides of it. A surface trench and shallow drive cutting through the dyke stuff reveal brown and red clays, with numerous veins of oxides of iron and manganese. In parts there is so much of these that the clay becomes almost a gossan. In this trench a lode about four feet thick, consisting of quartz mainly, but much coloured with iron and manganese oxides, has been cut through. Chloride of silver is freely visible in many stones from this lode. On either side of the lode the dyke stuff is extremely decomposed, and much blackened by oxide of manganese. I was told that the dyke stuff contained a little silver. This lode strikes N. 60° W. in the trench, and underlays S.W. about 1 in 6. All the surface immediately over the dyke is covered with gossan. Several other cuttings into the gossan formation have revealed the igneous clay lying beneath it. A tunnel was being driven at the time of my visit through hard limestone, in order to reach the dyke. When this has been driven right across the latter it will give a good idea of how much of it is payable.

A lode of blende in quartz, striking N. 45° W., and dipping to the N.E., is cut in a trench near the creek, and again a few chains away. This is from 6 to 8 feet wide, and looks like a strong lode. Its value has not yet been ascertained. The blende is reported to contain cadmium. This lode ought to be prospected, as it may contain galena. Thin veins of galena have been found in the limestone, which is a very congenial matrix for this ore, and a strong lode traversing it might be rich in it.

Godkin's Extended, (Section 1076-87).—The gossan outcrop found on Bell's sections continues through Smith's (916-87M) and into this one. An adit has been driven a distance of 445 feet to cut the line of the gossan at a depth of 250 feet. The drive was through soft sandstone and slate, and again into hard sandstone. At 412 feet a lode of blende, some 14 feet thick, carrying, it is said, 11 per cent. of lead and 73½ ounces of silver per ton, was passed through. This lode was of a cellular loose character. It has not yet been driven on, but should be. In the face a strong stream of water was struck, and hopes were entertained that the lode was not far off. I have not since heard if it has been found. To the north of this main tunnel and over a hill from it a shaft has been sunk to a depth of 83 feet, through soft sandstone stained with manganese oxides. Some of this stuff is said to have given a little silver on assay. An adit, 105 feet in length, has been driven towards the shaft in a south-westerly direction. The first 65 feet of this is through clayey matter stained with oxides of manganese, and then hard sandstone is met with. To the north of this adit, and a few chains distant, the decomposed dioritic rock is again met with.

Godkin's, (Sections 1599-87M and 1615-87M).—The main features of this property resemble those of Bell's section. The dyke in this case lies between sandstone and limestone. Strong outcrops of gossan lie over the surface of the ground, some parts of it giving very fair assays. A good deal of driving has been done to prove the ground. What is known as No. 1 tunnel has been driven about 300 feet right through the dyke. The first 100 feet consists of much stained very much decomposed dioritic rock containing a little silver. About 30 feet of this is stained very much, and contains a great deal of iron and manganese oxides and some quartz. This portion assays well for silver. One or two rich veins of phosphate of lead carrying chloride of silver were found through it. The remainder of the drive is through dioritic clays, and in the face sandstone makes its appearance. The dark rich portion of the dyke is the only part of it that can be said to be lode-matter, and it is not definitely formed into solid lode-stuff, but is only broken country rock (mullock) infiltrated with minerals from the lode solutions. In parts quartz lodes are likely to be found, as in Bell's. About 40 feet north of the mouth of No. 1 tunnel a shaft has been sunk 60 feet on the edge of the dyke. At 40 feet limestone was struck. About 30 feet to the south of the mouth of the tunnel an air-shaft has been sunk to meet an adit coming in at a lower level. For 36 feet the shaft passed through dioritic clay, and then struck loose broken limestone. The tunnel to meet this shaft is known as No. 4. It runs in from the creek in a direction N. 10° W. About 200 feet of it was driven through dioritic clays, and then 30 or 35 feet through limestone. It is to be continued to cut the main dyke and lode. Another drive, No. 3, has been put in about 90 feet, some little distance higher up the hill than No. 1. This passes through about 12 feet of the dioritic clay, and then goes through beds of sandstone and slate, among which I noticed also a thin bed of coarse grit. These beds strike N. 30° W., and dip S.W. 42° near the mouth of the tunnel, but much steeper in near the face. The end of the drive is in hard white sandstone. No lode was cut in this drive. In the northern of the two sections held by this company (1599-87M) there is yet another drive running about N. 80° W. This is about 100 feet long. It passes through 12 feet of dioritic clay, then 33 feet of mullocky lode stuff containing white clay and oxides of iron and manganese. Some silver chloride was also found in this. The lode-stuff here resembles that in No. 1 tunnel. The remainder of the drive is in sandstone, striking N. 30° W. and dipping S.W. 87°.

Taking all the properties on the line of this dyke into consideration, it may be said that while they all have been proved to contain silver, not one of them is yet opened sufficiently to warrant any glowing estimate of their value. The long distance over which silver-bearing material has been found, and the occasional occurrence of veins of quartz carrying chloride of silver, and of phosphate and chromate of lead, induce one to believe that there must be one or more true lodes along the line of dyke. But these lodes have still to be developed. In the meantime the erection of works for recovering the silver is quite premature, as the nature of the ore to be dealt with is yet uncertain. Galena may be found in the lodes in quantities to make smelting the best mode of treatment for all the ore; or it may be that the quantity of lead ore may be insignificant, and that the Lixiviation Process may be sufficient to extract the silver. Until a great deal more work has been done, and both quantity and quality of the ore have been proved, no reduction works need be thought of. The metallurgical treatment of the ore is far too important a matter to be lightly decided on. As both limestone and ironstone exist plentifully in the district, smelting is the most obvious method of dealing with the ore, provided that sufficient lead ore can also be obtained.

But the supplies of lead ore in sight, taking the Heazlewood line of lode into account as well, are not sufficient as yet to warrant the erection of furnaces. While, therefore, the prospects of the district quite warrant a large expenditure in opening up the mines, it is only fair to warn investors that a considerable time must elapse before they can hope to receive dividends.

PROSPECTS OF THE WEST COAST GENERALLY.

It is impossible to travel over the ground covered by the above report without being convinced of the vast importance to the Colony of this western portion of it. The difficulties in the way of prospecting are so great that one must admit the probability that the discoveries already made are only a small fraction of the total mineral wealth, and that as the country is opened up the yet unexplored portion will be also found to be rich. From the Arthur River to the Gordon valuable minerals have been found—gold at the Specimen Reef, at the Long Plains, in numerous branches of the Pieman River, at the Howard Plains, Queen River and its branches, and at Mount Lyell, and generally right throughout the whole country side; then we have tin ore at Mount Bischoff and at Mount Heemskirk, silver and lead ores at the Heazlewood, Mount Zeehan, and Mount Dundas, and other minerals of less importance also in various parts. And these have all been found in the midst of some of the most dense and impenetrable forest on the face of the earth, through which the prospector cutting his way has infinitely greater chances of missing than of striking the mineral deposit he is looking for, and where all his food and supplies have to be laboriously carried on his back. Can we be wrong, then, in looking upon the present discoveries only as an earnest of many more to come when the bush has been opened by tracks and there are fifty prospectors out where hitherto there has been but one? The Great Western Range yet holds its treasures intact, but we may soon expect to hear of successful assaults upon its fastnesses. The prospector—pioneer of the wildest wastes—is still pushing on; neither hardships nor danger can daunt his persevering courage. Though the swollen river sullenly roar across his path, though frightful scrubs entangle him in heartbreaking toils, though the inclement sky pour ceaseless rain upon him, yet do they not prevail to drive him back. Forward, still forward, is his resistless march, till the conquered crag glows red in the blaze of his cheery camp fire, and the gloomy valley re-echoes the ring of his axe. The rough places he makes smooth, and into the dismal dens he lets light, till the beaten demons of the mine fly affrighted and yield to him their long-guarded treasures. All honour to the undaunted heart that faces and overcomes the wilderness! He well deserves the grateful thanks of his country.

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

A. MONTGOMERY, *M.A.*,
Inspector of Mines and Geological Surveyor.

The Secretary of Mines, Hobart.

APPENDIX.

"NOTES ON MATTE SMELTING FOR SILVER."

Under this title a short paper appears in "The Engineering and Mining Journal" of February 8th, 1890, written by Mr. F. L. Bartlett, a well known American smelter, and from it the following remarks on the process are taken:—

"It has always been my belief that not enough attention is paid to the smelting of argentiferous ores without the use of lead. American smelters have not, as a rule, appreciated the idea that silver and gold can be concentrated and saved by the use of sulphur, iron, and copper as well as by the use of lead. There are many places in the West where silver ores occur in quantity, and of a fairly good quality, but are bare of lead; such ores do not always contain copper, but as a rule do, and usually run from 1 to 3 per cent. in that metal.

"In my own practice I have found no difficulty in saving gold and silver by smelting, either when copper was present, or when the ore contained only iron pyrite.

"Experience has shown that a small percentage of copper enables one to make a much higher concentration of the silver and gold present than is the case when the matte must be made wholly of sulphide of iron. When no copper or lead is in the ore, it has not been possible in my work to run the matte higher than 70 or 80 ounces of silver per ton, and make clean slags, *i.e.*, slags containing less than 1 ounce silver; but with copper, even as low as ½ per cent. in the charge, the silver can be run up to as high as 200 ounces; and with 3 per cent. copper in the charge, it can be run up to 700 ounces. Moreover, if the charge runs higher in copper than 2·5 or 3 per cent., no additional advantage is had; on the contrary, there is likely to be more loss of silver, therefore 3 per cent. may be considered the limit of the *best* results. The reason for this is, I believe, to be found in the fact, that when an ore containing a small percentage of copper is smelted, a very high degree of concentration can be made without forcing copper into the slags; thus, with an ore containing 3 per cent. of copper, a concentration of 20 to 1 can be made, and the matte then only contains 55 to 58 per cent. of copper, while slags from such ore will rarely contain more than one-tenth to one-twentieth per cent. of copper. If the ore ran 10 per cent. in copper, a concentration of not more than 5 to 1 would be possible, and even then the slag would be likely to run from ¼ to ½ per cent. copper, which means loss of silver.

"The ores most suitable for matte smelting in the blast furnace are those containing considerable iron or manganese, and the sulphur contents must be regulated by partial roasting when high, or by the addition of raw sulphurets when low, since the amount of sulphur present determines almost exactly the quantity of matte made."

Mr. Bartlett then proceeds to quote from notes received by him from Mr. Herbert Lang, Manager of the Porphyrite Silver Mining Company of Mineral City, Idaho. Mr. Lang writes :—

"At the Porphyrite Company's smelting works we use a 36-inch Bartlett water jacket, with outside settling wells, and run off the melted products continuously. The proportion of ore smelted to matte produced is 20 or 25 to 1, an excessively high rate of concentration, but, under the peculiar conditions prevailing at this isolated camp, more profitable than a greater proportion of matte would be. The silver extraction is quite satisfactory, our slags assaying, week in and week out, only about 1½ ounces of silver per ton. The loss in flue dust probably amounts to 2 per cent. We use a blast of 6 to 8 ounces pressure, generated by a No. 6 Sturtevant fan, which requires about 10 H.P.

"Our mines produce two general classes of ore, denominated oxidised and sulphide ores. The former are well represented by the following :—

* *Analysis of Oxydised Ore.*

Moisture	10·00
Copper	3·00
Silica	40·20
Sulphur	0·79
Oxides of iron	28·63
Oxides of manganese	1·35
Alumina	7·31
Lime	1·56
Magnesia	0·57
Cobalt, nickel, zinc	0·60
Oxygen and carbonic acid, &c.	5·52
	99·53

* Such ores carry on an average 40 ounces of silver—no gold.

Analysis of Sulphide Ore.

Moisture	4·00
Silica	27·77
Sulphur	6·18
Copper	1·20
Iron, as oxide and sulphide	17·78
Alumina	4·80
Zinc	1·73
Lime	11·00
Magnesia	0·63

(Oxygen, combined water, carbonic acid, and various unimportant constituents not estimated.)

"By a suitable mixture of these ores, and by adding limestone as flux, we obtain a slag of the following percentage composition :—

Analysis of Slag.

Silica	37·05
Ferrous oxide	17·66
Manganous oxide	7·85
Lime and magnesia	28·72
Alumina	7·43
Sulphur	0·38
Zinc oxide	0·41
Copper	0·10
	99·60

"Accompanying this slag there is, as before remarked, a matte carrying about 36 per cent. copper and several hundred ounces of silver, with a trace of gold. This we sack, and ship east to market."

Mr. Lang then goes on to describe some features of the furnace manipulation, and concludes :—

"Making the rather acid slag shown by my analysis, we are not able to smelt the maximum amount due to this size furnace. We average 14 tons' charge each 12 hours' run, while running only one shift, which corresponds to about 30 tons daily. For experimental purposes, and making a more basic slag, we have, for some hours, smelted at the rate of 40 to 50 tons per day, which demonstrates sufficiently that our furnace is at least equal to any other well known make in capacity. We smelt on an average eight and a half tons of charge to one ton of Connellsville coke."

18/19

THE NEW DRESSING WORKS OF THE ST. JOSEPH LEAD COMPANY, AT BONNE TERRE, MISSOURI.

The *Engineering and Mining Journal* of June 22nd and 29th, 1889, has an illustrated description of the above dressing works taken from a paper read by Professor H. S. Munroe before the American Institute of Mining Engineers. Being built in 1883, this mill is a comparatively modern example of American modes of dressing lead ores. The new mill, which has a capacity of 800 tons a day, was built in consequence of older sheds having been burned down. The old mill had at one time or another contained almost every known form of dressing apparatus, and "the new mill represents the results of fifteen years' study and experiment in the old structure, and is a shining example of 'the survival of the fittest,' both in apparatus and in method of treatment."

Outline of Method of Treatment.

"The method of treatment may be outlined as follows:—The ore is crushed by jaw-crushers and rolls, and screened dry through a 6m.m. screen. The sands passing through the screen are thoroughly mixed with water, and elevated by centrifugal pumps to distributors, and divided among the Parsons' jigs without any previous sizing or classification. The tails ("chats"), after passing over the two sieves of these jigs, receive no further treatment, and are conveyed by launders to the "chat-tanks." Coarse galena and raggings are skimmed by hand from the jigs at intervals, leaving always a sufficient bed to ensure good hutchwork. The hutchwork that comes through the sieves of the Parsons' jigs pass through a series of spitzkasten. The heavy galena mixed with some sand and slime settles in the first box of the series, from which it is fed to a trunking-machine. The pure galena from this machine falls into railroad cars and goes to the smelting works. The tails from the trunking-machine, together with the sands settling in the second box of the spitzkasten, are elevated by the centrifugal pumps, and divided between the Hartz three-sieved jigs. The tails of the Hartz jigs receive no further treatment, going directly to the chat-tanks. Galena and pyrites are skimmed from the sieves of these jigs. A bed of galena is, however, maintained on all three sieves, so as to insure a rich hutchwork. The hutchwork of these finishing jigs is nearly pure galena, and goes to the galena boxes on the lower floor, which are emptied from time to time, and the galena, loaded on cars, goes to the smelting works.

The fine slimes settling in the third and fourth boxes of the spitzkasten are united, and raised by centrifugal pumps to the distributors, feeding the first row of Parsons' Rittinger tables. The middlings from these tables are treated on the second row of tables. The tails from all the tables flow into the chat-tanks, and the heads run into galena boxes on the lower floor, from which they are loaded into cars.

The raggings, containing from 12 to 20 per cent. of lead, which are skimmed from the Parsons' jigs, are recrushed by fine rolls and elevated without screening to a line of Hartz three-sieved jigs. These raggings contain considerable pyrites."

The paper then goes on to describe in detail the various machines used and their arrangement, the description being made clear by numerous illustrations, for which we must refer those interested in the subject to the original paper.

There are ten sets of crushing and screening apparatus in the mill, each treating about 80 tons in twenty-four hours. Each set consists of a 7-inch by 15-inch Blake crusher, lever pattern, with corrugated jaws; a pair of Cornish rolls, 14 inches by 30 inches, with chilled tires; a revolving screen, 3 feet diameter by 8 feet long, with six millimetres perforated steel plates, a bucket elevator for the material coarser than six millimetres, and a centrifugal pump.

The jaw-crushers are set to crush to about 38 mm. or $1\frac{1}{2}$ inches, and the rolls to crush to about 16 mm., or $\frac{5}{8}$ inch. Of the material passing through the rolls at any time, about one-third is too coarse to pass through the screens, consequently the ore passes through the rolls one and a half times. While the perforations of the screens are 6 mm. in diameter, not more than 2 per cent. of the screened product is coarser than 4 mm.

Each crusher was found to cost about £21 a year for repairs, and each pair of rolls about £30 10*s*. New screens came to close on £33 a year.

The Parsons' jigs used for the preliminary jigging of the sands coming from the rolls are two-sieve under-piston jigs, each sieve 24 inches by 39 inches (or 22 by 27 inches in the clear). For convenience the jigs are made double, *i.e.*, four sieves, or two jigs, are united in one machine. There are 9 jigs, $4\frac{1}{2}$ machines, for each set of crushing apparatus. Each jig treats, therefore, about 9 tons in 24 hours. The ore dealt with contains on an average 8·93 per cent. of lead. The hutchwork saved from the jigs contains 22·3 per cent., and the raggings, or coarse sand and galena 16·54 per cent., while the tailings contain 1·53 per cent. By this jigging treatment, 800 tons of ore a day are at once reduced to 136 tons requiring further dressing, namely, 30 tons of raggings, crushed and treated on the three-sieve jigs, 66 tons of fine sand also treated on three-sieve jigs, and 40 tons of slime treated on side-bump tables. The hutchwork is next classified in a series of four spitzkasten or pyramidal boxes. The coarse sand in the first box is dressed in the trunking machine to nearly pure galena. The tailings from this and the sand from the second box are treated on three-sieve Hartz jigs of the ordinary side-piston type. The hutchwork of these contains 74 per cent. of lead, and the tailings 5·24 per cent. The fine slimes from the third and fourth spitzkasten are treated on double Rittinger side-bump tables, 3 feet by $7\frac{1}{2}$ feet, built in pairs. There are 16 pairs of double tables in the mill, or 64 tables in all. Of these 32 are head tables and 32 are used for treating middlings. They treat $2\frac{1}{2}$ tons per double table in 24 hours.

The average loss in the tailings in this mill in 1887 was 2·13 per cent. of lead, or 27·4 per cent. of the total amount of lead in the ore. The cost of dressing amounted in the same year to 36·4 cents per ton, (about 1*s*. $6\frac{1}{4}$*d*.) divided as follows:—Labour 13·4 cents, repairs 10·0, supplies 3·5, coal 9·5—total 36·4 cents.

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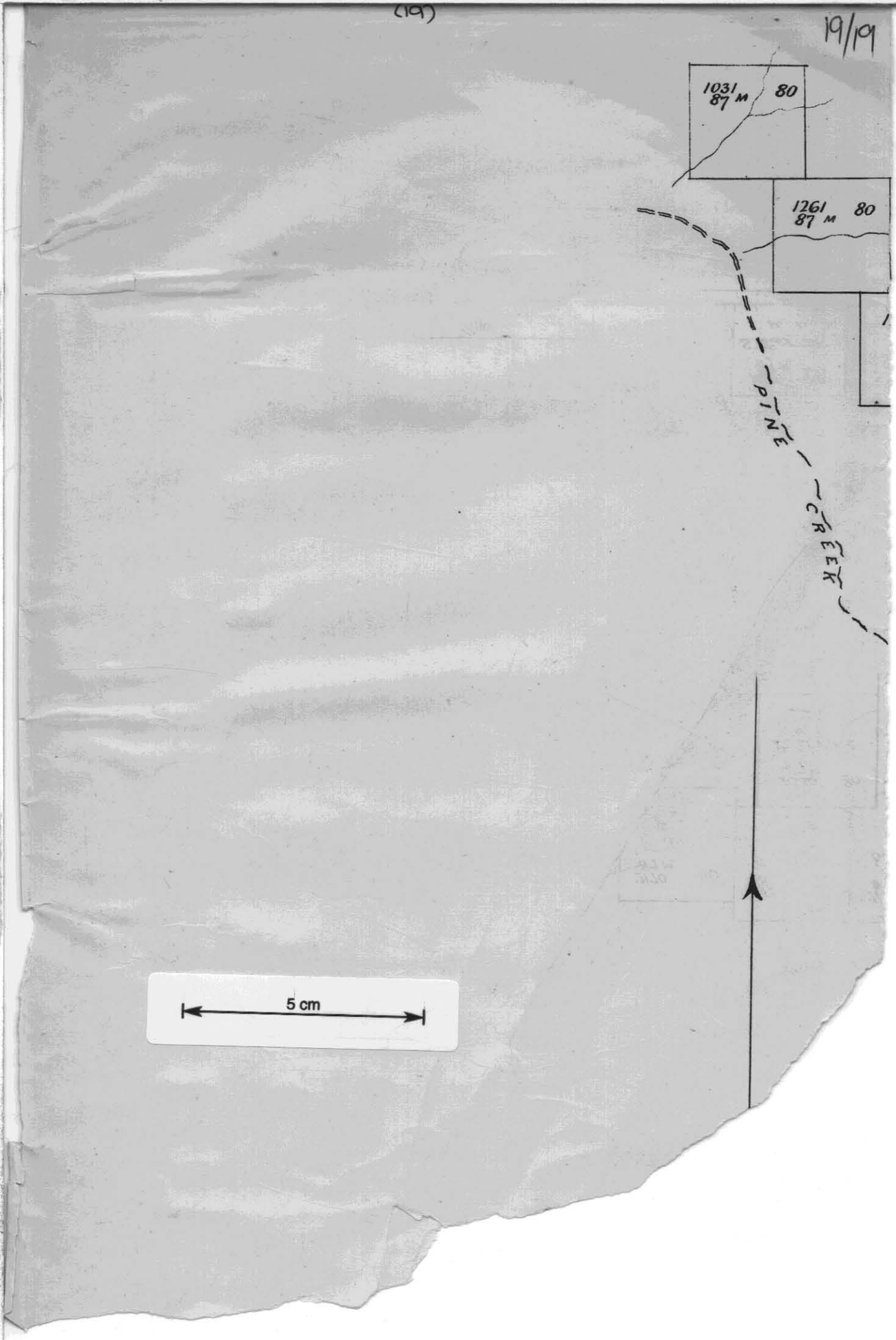
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