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REPORT ON THE MINING DISTRICTS OF
THE SCAMANDER RIVER AND ST.
HELENS.

Government Geologist's Office,
Launceston, 4th June, 1901.

SIR,

ACTING on instructions received from Mr. W. H. Twelvetrees, Government Geologist, I left Launceston on the 22nd of April last to examine and report upon the mining districts in the vicinity of the Scamander River and St. Helens. I am indebted to the kindness of a number of gentlemen whom I met on my journey for information concerning the districts visited, especially to Mr. Paul Beahr, who accompanied me throughout the Scamander River Copper Field, and also to Messrs. H. Grant, T. Haley, Geo. Briggs, B. H. Whittle, and others, who supplied me with much information concerning mining at St. Helen's.

The metals found in the Scamander River and St. Helens districts consist principally of copper, tungsten, and tin. I deem it advisable to divide my report into three parts, the first dealing with the deposits of copper ores north of the Scamander River, and including one deposit (the Silver Echo Mine) near St. Helens, but in the same line of country as the Scamander deposits; the second describing the deposits of wolframite south-west of St. Helens; and the third part dealing with the alluvial deposits of tin at the Scamander River and in the vicinity of St. Helens.

COPPER DEPOSITS IN THE DISTRICT NORTH OF
THE SCAMANDER RIVER.

The area in which the deposits of copper-ore about to be described occur is situated to the north of the Scamander River, and extends to within a few miles of the Town of St. Helens. The rocks consist, for the most part, of shales or slates, sandstone, and quartzite, striking from 15° to 30° west of north, and dipping, for the most part, at high angles to the west. Granite has evidently played a most important part in the geology of

the district. A massive belt of this rock runs parallel to the coast line from St. Marys to St. Helens, forming the core of the Scamander range of hills, and, according to the observations of Messrs. Montgomery and Harcourt Smith, forms the axis of a large anticlinal fold, the strata dipping away from the granite on either side. To the north of the area is the great mass of granite of which the Blue Tier and Mount Cameron form a part, and from this mass other dykes and tongues of granite or granite porphyry protrude into the sedimentary rocks for long distances. Contact metamorphism is distinctly noticeable in many places, and often extends for considerable distances away from any observed line of contact. This is especially noticeable in the northern portion of the district, where we find sandstones altered to quartzites, and shales and slates indurated and changed into a hard compact rock of the nature of hornstone. Many of these indurated slates contain numerous small concretions of a faintly glimmering substance, probably representing the incipient stage in the formation of crystals of such minerals as chiastolite. No fossils have as yet been found in these rocks, notwithstanding the fact that they have been diligently searched for by several gentlemen who interest themselves in the geology of the district. The only clue, therefore, that we have as to their age is the presence of the granite. The sedimentary rocks are evidently older than the latter, for they have suffered metamorphism at their contact with it. Granite in Tasmania is believed to be of Devonian age, and consequently we may assume that the sedimentary rocks are of the Silurian, or possibly of some still older, period.

The area is traversed by numerous small streams, mostly affluents of the Scamander River, running in steep gullies, separated by bold ridges, and making the country very rugged. The surface is, for the most part, devoid of undergrowth, though covered with a fine forest of ironbark timber, which would become very valuable if mining in the district became prosperous. The absence of undergrowth makes most of the country easily accessible to the prospector, and it is to be regretted that up to the present the district has not received the attention it undoubtedly deserves.

The Eastern Proprietary Silver and Copper Mining Company, No Liability.

This company holds Sections 56-93M and 57-93M, each of 80 acres. The mine is situated about 3½ miles to the north-east of the Township of Yarmouth. It is the only copper mine in the district on which any considerable amount of work has been done. The lode on which the company has been working is a very strong one, and may be traced by means of its gossanous outcrop, running diagonally through the two sections held by the company, and for considerable distances both north and south of them. In all, the lode is traceable for close on two miles. The strike is as nearly as possible N.W. and S.E., and the dip is to the west at a steep angle. A long tunnel has been driven on the course of the lode, commencing in the valley of a creek which crosses the lode in the southern portion of Section 56-93M. North of this creek the outcrop follows the crest of a high narrow ridge, which in places rises more than 500 feet above the tunnel level. I think it probable that this ridge owes its existence to the presence of the lode. The shales and sandstones on either side have been permeated by silicious solutions from the lode, and becoming hardened, have offered greater resistance to the agents of denudation. On the surface the lode-matter consists of brown oxide of iron, iron-stained kaolin, ferruginous cherty matter, and occasionally veins of quartz, but no copper minerals. Chloritised slate generally accompanies the outcrop, and from this a reaction for copper may often be obtained with the blow-pipe. The tunnel has been driven along the western wall of the lode, and follows a seam of kaolin and decayed lode-matter almost the whole distance. In a number of places short cross-cuts have been put in in a north-easterly direction from the drive to prove the width of the lode. These have shown that the total width of the formation is not less than 20 feet, but it is very questionable if all this can be classed as lode-matter; it consists principally of partially decayed slate, much jointed and shattered in a direction parallel to the lode, and some of this contains considerable quantities of black oxide of copper in the joints. The main lode-channel, however,

through which the mineral-bearing solutions originally circulated, is evidently represented by the seam of pug along which the tunnel has been driven.

In entering the tunnel, for the first 70 or 80 feet, the whole lode-matter, or the metallic contents thereof, have been leached away, and no copper minerals are to be seen. After this the pug seam becomes stained green with copper sulphate, and other oxidised copper ores appear.

At 150 feet from the entrance the first pay shoot was struck. The ore, which consisted of black and red oxides of copper (melaconite and cuprite), green and blue carbonates (malachite and azurite), and copper sulphide (chalcocite) was discovered just in the bottom of the drive, and it is possible that had the latter been put in two or three feet higher the shoot would never have been found. A winze was put down, and at a depth of 12 feet water was struck, which stopped further sinking. The ore above water-level was, however, stoped out, and yielded 20 tons of high-grade copper ore. The length of the shoot at water-level was 25 feet, or, in other words, its length increased from practically nothing to 25 feet in a depth of 12 feet. The ends of the stope are in grey, decomposed slate, carrying a fair percentage of black oxide of copper, but not sufficient to pay for mining under present circumstances. To the east of the stoped ground a chamber has been taken out, 10 feet wide and 12 feet in length. The character of the stone in the ends of the chamber is much the same as that showing in the ends of the stope, and carries black oxide of copper freely through it, though whether payable ore was got from here I was unable to ascertain. For the next 250 feet along the course of the lode the drive follows the same pug seam, and all along the latter is stained a bright green with copper sulphate. This mineral, it should be noted, has been formed since the drive has been put in. It represents the leaching of the lode above the tunnel, and has only been precipitated in the tunnel by evaporation. Nowhere does it occur in payable quantities. At 400 feet from the entrance the second pay shoot was struck. This shoot was of exactly similar nature to the first, but rose above the tunnel for a distance of 20 feet before it cut out. It has been

stopped out to water-level (again 12 feet below the tunnel), and at that depth proved to be 70 feet in length. In all, 296 $\frac{3}{4}$ tons of ore were obtained from this stope, of which 100 tons mined in 1896 yielded an average of 28 per cent. of copper and 17 ozs. of silver; and 196 $\frac{3}{4}$ tons mined during the latter portion of 1900 yielded an average of 17 per cent. of copper and 13 ozs. of silver. A winze was put down at this point for a distance of 85 feet, and is said to have been in payable ore all the way, but, owing to the water present, this could not be taken out. Six inches of chalcocite are said to be showing in the bottom of the winze. The shoot is said to have been 8 feet in width at its widest point. The drive has been continued on the course of the lode for a total distance of 870 feet, but, owing to the ground having fallen in, I was unable to examine it further. The general character of the lode is stated to be the same throughout, but no more rich pay shoots were struck.

At 400 feet from the entrance of the tunnel a crosscut was put in on the hanging (western) wall, at right angles to the drive, for a distance of 200 feet. For the first 150 feet the country is sandstone, with a little shale interbedded; after that there is more shale than sandstone. At 160 feet a winze was put down on a seam of kaolin and decayed rock, and at 16 feet, at water-level, a seam of about five inches of black copper ore (chalcocite?) and iron pyrites was struck. Owing to recent rains there were two feet of water in the bottom of the winze, and I was unable to examine it.

At 450 feet from the entrance another crosscut was put in, in a north-easterly direction; and at 30 feet a winze was put down on a vein of puggy matter, containing black copper-ore. The depth of the winze is stated to be 16 feet, water having been struck at 12 feet. At water-level four inches of black copper-ore were found.

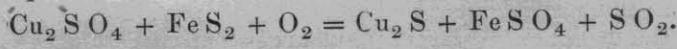
On the southern section (57-93M) a second tunnel has been driven along the course of the lode for a distance of 40 feet. Beyond finding the presence of copper, however, nothing of importance was discovered. The lode here is of essentially the same nature as in the other tunnel.

It will be evident from the above description that there is very little hope of finding copper-ores in payable

quantities, or in quantities that will pay the present cost of transportation, in the oxidised portion of the lode. The lode has already been driven on for a distance of 870 feet, and only in one place has payable ore been found above tunnel-level, and this was only the top of a shoot of ore which rises a little higher above water-level than usual. In order to be able to come to any conclusion as to the probability of payable shoots being found below water-level, it will be necessary to inquire into the chemical and geological processes which have been at work. The copper mineral originally deposited in the lode at the time of its formation was no doubt chalcopyrite, the common sulphide of copper and iron, which experience has shown to be, in the vast majority of fissure-lodes, the primary copper mineral. This was associated with iron and arsenical pyrites, quartz, a little zinc-blende and galena, and, probably, other minerals. Since its formation, however, denudation has been actively at work, and has excavated deep gullies in the vicinity, which carry away the surface water and lower the level of the ground water. The result is that a large part of the lode is exposed to the oxidising action of the surface waters. The permanent water-level is now, as shown by the mine-workings, about 12 feet below the level of the tunnel. Above this the lode has been subjected to the action of waters trickling down from the surface along the lode-channel and carrying with them oxygen gas. These waters quickly change the insoluble iron and copper sulphide into soluble sulphates, and in this form carry them downwards till they reach the water-level. This action is still going on, as shown by the water, heavily charged with copper sulphate, passing down the sides of the tunnel, and which, on evaporation, deposits its mineral contents. When the copper-bearing solutions reach the permanent water-level, movement does not cease; it tends to flow towards the surface at some lower level, and in doing so, it will utilise the entire available sectional area of the openings leading thereto. But the extent to which these openings are utilised will be inversely proportional to the amount of resistance which they offer to flowage, and this will depend upon their relative size and the distance which the water must flow before reaching the surface. The result will be

that, in most cases, the flowage will be principally confined to the lode-channel. Concerning the direction of flow in the lode-channel, this will have a vertical, as well as a horizontal, component, and the vertical component will be greater, or the amount of water flowing downwards will be greater, in proportion as the distance of outflow is greater. These general principles, however, are probably, in reality, greatly modified by the irregular distribution of the openings in the lode-fissure, and it is probable that the bulk of the water follows certain paths of least resistance, which occasionally may carry it to great depths before it again emerges at the surface.

We have now to consider the action of these solutions of sulphates on the unaltered ores below water-level. These, as I have already pointed out, consist largely of sulphate of iron, the latter mineral, contrary to what is often stated, is less soluble than copper sulphide. The result of contact of copper sulphate with iron sulphide will be a chemical substitution. Copper sulphide will be precipitated and iron sulphate will go into solution. This reaction has been proved experimentally by Schürmann, and may be represented by the following equation:—



Similar equations may be readily made to represent the alteration of iron pyrites to bornite or chalcopyrite; or the alteration of chalcopyrite to bornite or chalcocite; or the alteration of bornite to chalcocite. All these reactions may take place, and the presence of large quantities of these rich copper sulphides at water-level, and for some distance below it, in the case of lodes the upper portions of which have been subjected to oxidation, is satisfactorily accounted for. This subject has lately been dealt with exhaustively by C. H. Van Hise, in a paper read before the American Institute of Mining Engineers, entitled "Some principles controlling the deposition of Ores," and is well worth consulting.

In the case of the Eastern Proprietary Mine, the presence of the enriched zone has been proved beyond doubt, and it remains for the future mining operations of the company to prove its extent. Only the top of the zone has been reached so far, and the ores have been

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proved to be rich in copper. The possibilities are very great. As a somewhat similar occurrence may be mentioned—the copper lodes at Butte Montana. The latter have been described by S. F. Emmons, as follows:—"The prominent characteristics of the Butte copper lodes are, firstly, an upper oxidised zone extending down from 200 to 400 feet from the surface, which contains less than one per cent. of copper on the average, the values being principally in silver; it is a mass of crumbly honey-combed quartz, singularly free from metallic oxides, when one considers the great mass of the original sulphides found in the veins in depth: secondly, below this is a rather ill-defined zone, characterised by great values in the rich copper sulphides, bornite, and chalcocite or copper glance, associated with pyrite and chalcopyrite. The proportion of these rich sulphides gradually decreases with depths, until, in some mines, the ores consist only of pyrite, with a slight admixture of chalcopyrite. Enormous amounts of copper-glance were found in many of the mines; generally, in the upper levels of the sulphide zone. Sometimes they constituted solid masses, 15 feet or more in thickness, in which, however, close examination showed a sprinkling of chalcopyrite or pyrite, in minute, irregular, and often pitted grains throughout the mass of the glance. Not infrequently the cleavage faces are coated with very thin films of native silver."

The Scamander lodes differ from these in the upper levels principally by their poverty in silver. The gossans met with have all been poor in this metal, though containing it in appreciable, but unpayable, quantities. It is not likely that bodies of such extent will be found here as at Butte, for the upper portion of the lode is not so wide, but I believe that the nature of the concentration of the sulphides is the same in both places. Obviously, there is only one thing to be done with the mine; namely, to sink and drive along the lode at a lower level. I should recommend the shaft to be put down near the mouth of the present tunnel, and to open out at 150 feet. At this depth the probability of striking rich shoots is very great, and the risk, from an investor's point of view, is very small. Should developments warrant it, and I think there is every reason to hope that they will, deeper levels could be opened, and the mine worked to as great

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a depth as payable ore exists. Pumping machinery will probably have to be erected, but it would be worth while to try bailing with tanks before going in for an expensive pumping plant. In any case the creek at the tunnel entrance should be flumed for some distance on either side of the lode, in order to prevent the water from flowing into the mine. This would not be a very expensive item, as the creek is not a large one. A good cart road has been lately made into the mine, connecting it with the road on the south side of the Scamander River, at Berwick's Farm.

The Paul Beahr Prospecting Association.

Sections 4000-93M (40 acres) and 5161-93M (5 acres). This mine is situated south-east and adjoining the Eastern Proprietary Mine. The Eastern Proprietary lode may be traced right through the property. Much of the country here is overlaid by a very coarse sub-angular wash, or *débris*, of Tertiary age, which forms the capping of several of the hills in this vicinity, the creeks cutting through this and into the solid country. The lode, of course, does not live into the capping, but its course is, nevertheless, marked by the presence of bog iron in the wash, which acts in places as a cement for the fragments of *débris*. The true lode is found in the valleys of two creeks which flow into the "Right Arm" of the Scamander River; and also on the banks of the latter river itself. On a mining easement, situated on section 3976-93M, a tunnel has been driven cutting the lode, and the latter has been driven on for a distance of 300 feet. Where first struck the lode contained galena and pyrites distributed freely through the lode matter. The galena, when concentrated, is said to have given a return of 64 per cent. lead and 84 ozs. of silver. This lasted for 70 feet, after which the lode was filled with pug and broken slate, containing pyrites, but no galena: this lasted for 130 feet. For the last 100 feet the lode contains about a foot of pyrites, showing evident signs of decomposition. It contains, in places, a lot of zincblende and oxidised zinc ores, as well as patches of black copper ore. The tunnel was put in only about 20 feet above sea-level; the water in the "Right Arm," which is just below the tunnel, being brackish. The lode, probably, does not

rise more than 70 feet above the tunnel, for the hill above is capped with tertiary *débris* or wash. The idea of the management appears to have been, that the lode, being protected by the capping of wash overhead, might be expected to be found in its original state, and that the rich sulphide ores met with at water-level in the Eastern Proprietary Mine, might be found at the adit level in this mine. This pre-supposes that the rich sulphide ore is the primary ore of copper, which, I believe, is not the case; moreover, notwithstanding the capping of wash, a considerable amount of oxidation has taken place. I think, however, there is still the possibility of finding rich patches in this mine, though I cannot regard the indications in as favourable a light as at the Eastern Proprietary. The mine being situated at such a low level, and being capped with wash, there is not the extent of lode overhead from which large concentrations could be derived.

Section 229-93M.

40 acres. This section is situated to the north-west of the Eastern Proprietary Mine, there being one 40-acre section (4089-93M) intervening. The Eastern Proprietary lode may be traced through the section, the spur along the crest of which the lode runs reaching its highest point, namely 650 feet above sea-level, in this section. At about the centre of the section another lode, crossing the Eastern Proprietary lode, may be seen by its big gossanous outcrop, striking nearly north and south. This lode is well worth prospecting, but, like the Eastern Proprietary lode, it will probably be found barren in the upper levels. It is possible that the oxide zone might be got under by bringing in a tunnel from the north, where the spur falls steeply, but I think it probable that in this case also sinking will have to be resorted to before any satisfactory results can be obtained. The section is not held at the present time.

Sections 4126-93M and 4127-93M.

Each of 80 acres, charted in the name of A. Pfaff. These sections are situated north-east and adjoining the Eastern Proprietary Mine. Two lodes, both parallel to the Eastern Proprietary lode, occur on these sections.

They present the same gossanous outcrop associated with chlorite as the Eastern Proprietary. The most easterly of these lodes has been traced right through both sections, and most of the work done has been confined to this lode. In Section 4127, on the side of a rather steep hill, a shaft has been sunk 60 or 70 feet, but did not reach to the bottom of the oxidised zone; nothing but a little decomposed iron pyrites and traces of carbonate of copper were found. On Section 4216 a tunnel has been put in from the valley of a creek in a north-westerly direction, but again the lode was almost completely oxidised; a little arsenical and copper pyrites occurring in bunches surrounded by gossanous and mullocky lode-matter was found, but evidently the principal copper contents had been removed. A shallow shaft had been put down near the entrance of this tunnel, but as it was full of water I could not examine it. A good deal of trenching has been done on the lode, which in many places is very promising, but no rich patches were discovered; it is evident that this is a similar case to the Eastern Proprietary. The copper has been removed from the upper portions of the lode, and probably occurs in a concentrated form in the lower levels. A shaft should be sunk and the lode driven on at a fair distance, say 150 feet below water-level.

Section 745-93m.

80 acres—H. Robinson and D. Delaney. This section is situated about a mile to the west of the Eastern Proprietary Mine. Another strong lode, parallel to the Eastern Proprietary, runs through this section. A tunnel has been driven into the side of the hill with the object of cutting the lode, but work had been stopped before the lode was struck. I fear that at this level the lode will be found to be completely oxidised, but as so much has been done it would be worth while continuing the tunnel to ascertain the nature of the lode before deciding on future operations. The lode could be tapped at considerable depth by means of a long tunnel from the south, and in all probability this would be below the zone of oxidation.

Between Robinson's and Delaney's there are three other outcrops of apparently parallel lodes to the Eastern Proprietary, all on Crown land. Should other developments in the field prove the existence of payable ore

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bodies below water-level, these lodes will be deserving of attention.

The North Scamander Mine.

Sections 3940-93M, 3941-93M. This mine is situated about a mile to the south of the Eastern Proprietary. The workings are confined to the south-western portion of Section 3941-93M. A large formation, carrying iron and copper pyrites, pyrrhotite, zinc blende, galena, and magnetite, is exposed in the bed of a creek. The work has, unfortunately, been carried on in an unsystematic manner, the stone from one opening being thrown into the next, with the result that, although a good deal of work has been done there is very little to be seen, and I could form only an approximate idea as to the nature of the deposit. The magnetite is, apparently, confined to the north-eastern wall of the formation. Here it occurs fairly massive, with a good deal of pyrite and zinc blende and a little galena, and may be traced for several chains running in a north-western direction. To the north of the creek the minerals have the appearance of replacing quartzite, as they appear disseminated more or less strongly in that rock. To the south-west of this band of magnetite the country is very strongly impregnated with pyrites, and some nice copper pyrites has been got out of the trenches. The lode appears to be of a different character to the other lodes in the district. The ore is not the filling of a fissure, but is an impregnation from a fissure. The latter is worth locating and following up. This could be best done by means of a tunnel driven from the creek in a north-easterly direction, when it is quite possible that a payable ore-body might be struck. The ore has not undergone any large amount of oxidation at this place. From the strike of the magnetite ore-body it is possible that this is a continuation of Robinson's and Delaney's lode, which is evidently running in this direction.

The lodes which have now been described all lie in what has been known as the Scamander River Copper Field. No work was being done at the time of my visit, but it is to be hoped that this state of affairs will not be of long duration. There is, as I have already pointed out, a great hope of payable ore existing below water-level; and should this be proved to be the case, there are quite a number of

lodes which will be worth a trial. The value of the ore below the enriched zone is at present quite problematical, and I could not venture on an opinion as to its economic value. But the possibilities of the enriched zone itself are, in my opinion, sufficient to warrant the expenditure of the very limited amount of capital which will be required for its exploitation.

Section 4835-93m.

40 acres. E. P. Ryan and M. Fitzpatrick. This section is situated about five miles west of the Scamander River Copper Field. A little trenching has been done on a quartzite spur rising out of the valley of one of the tributaries of the Scamander River. A number of veins and bunches of copper, iron, and arsenical pyrites, up to six inches in width, occur somewhat irregularly in the quartzite. Assays up to 6 per cent. of copper and 3 dwts. of gold are said to have been obtained. Higher up the spur the rock is traversed by numerous veins of quartz, which, where opened on, are much iron-stained, and evidently contain a good deal of pyrites in depth. I also noticed the presence of chlorite, which, in this district, appears to accompany all the deposits of copper ores, though I failed to find anything which could be correctly defined as a lode. However, in the present state of development, it is impossible to say what may be found below the surface. It is very possible that if the spur were driven under a payable ore-body might be discovered.

The Silver Echo Mine.

Section 330-93m. 20 acres. This mine is situated about three miles south-east of St. Helens, and presents some features of exceptional interest. The country is a continuation of the Silurian strata, in which the copper deposits of the Scamander River district occur; but here they are greatly hardened and metamorphosed by contact with the granite. The southern extremity of the main mass of granite already mentioned is situated a short distance to the north of the mine. A small creek, an affluent of the Golden Fleece Rivulet, runs through the centre of the section with a northerly course, the sides of the valley rising steeply on either side. In the bed of this creek an open cut has exposed a very wide quartz formation, carrying

irregular bunches or masses of pyrrhotite, with a little pyrite, copper pyrites, and a whitish easily-decomposed pyrite, probably marcasite; some of the latter is said to have given as much as 15 dwts. of gold to the ton, but the majority of the metal is of low grade. In some of the quartz I noticed some needles of tourmaline, and Mr. H. Grant showed me a piece of pyrrhotite with a crystal of tourmaline imbedded in it from this mine. The strike of the formation is 15° to 20° east of north. Its width could not be accurately determined, owing to the eastern wall not being exposed, but it is probably about 40 feet. The quartz is singularly pure and homogeneous, white or smoky in colour, and, as far as I could see, no bands or fragments of country rock were enclosed in the formation. Associated with the quartz, and apparently forming the marginal portions of the formation, there is an extremely quartzose rock, composed of quartz, feldspar, and mica (biotite and muscovite), but with the quartz greatly in excess. The junction of this rock with the country is quite sharp and distinct, but there is no such defined line of contact between it and the quartz; there is rather a gradual passing over from the one to the other, the quartz gradually increasing in quantity until it entirely replaces the feldspar and mica. Unfortunately, at the time of writing, I have not received the slices of this rock for microscopic examination, but as it is moderately coarse-grained, the constituent minerals may be recognised macroscopically. I take the rock to be of the nature of an extremely acid granitic dyke rock. The whole formation is evidently the filling of a fissure, for it cuts across the stratification of the country. The question arises—How can this intimate association of an apparently eruptive or dyke-filling rock with the pure reef-quartz be accounted for? There has always been a tendency to regard the filling matter of fissures as divisible into two well-defined classes: one, formed by cooling from a molten condition, and the other, formed by precipitation from solution in water; and these classes have been called dykes and veins (or reefs). But here we have a fissure filled in part by a dyke-rock and in part by a vein-rock; and, as the one passes gradually into the other, it is impossible to assume a dyke origin for the one and a vein origin for the other. Whatever the mode of formation, it has been the same for

both rocks. The case is not, however, an isolated one. Instances of the passing over of granitic dyke-rocks (pegmatite, aplite, &c.) into quartz reefs have been noted by quite a number of geologists, especially of late years, and the opinion is gaining ground that no sharp line of distinction can be drawn between them, but that there are intermediate rocks which, according to the old definitions, cannot be strictly classed either as dyke-rocks or vein-rocks. I believe this is the case in regard to the Echo Mine.

It is well recognised now that granite is not a product of fusion by heat alone, but that the presence of water in the molten rock has played a great part in preserving the liquid state of the original magma down to comparatively low temperatures. It is believed that the magma existed in a state analogous to solution in water, the solvent power of the water being enormously increased by heat. This conclusion is principally based on three classes of facts. 1st. The order of solidification of the mineral constituents is not what we should expect from fusion alone. In granite, it is found that the acid minerals have solidified later than the more basic, and quartz has solidified last of all, for it is seen to occupy the spaces, or interstices, between the crystals of the other minerals. But quartz is much less fusible than the basic minerals, and under conditions of simple fusion should crystallise out before them. The difficulty is explained when we recognise the great solubility of quartz in small quantities of superheated water. 2nd. There is no baking, calcination, or fusion of the country rock in the vicinity of granite, such as is often found at the contact of basic rocks. All the contact phenomena indicate a comparatively low temperature. 3rd. The contact phenomena connected with granite have evidently been brought about by the action of mineralising waters, with which the granite was impregnated. This is shown by the enormous amount of silicification always observed, and the fact that porous strata have been altered to very much greater distances from the granite than strata which are comparatively impervious to water.

In a magma which is in the process of consolidation, the basic minerals are the first to crystallise out, and the residual liquid portion becomes more and more acid and aqueous with the progressive solidification of the basic

constituents. It is this residual liquid portion of the granite magma which I conceive to have been ejected from the granite mass into a fissure at the Echo Mine. It has been observed in very numerous instances that the marginal portion of igneous masses are of a more basic nature than the centre. This is no doubt due to differentiation or segregation during the progress of cooling, the minerals which solidify first having a tendency to segregate towards the margin. This process would be the more complete the larger the mass, and in the case of such an enormous mass of granite as we have to the north of the Echo Mine, the process of consolidation would be extremely slow, and the possibility of segregation correspondingly great.

According to this theory the Echo reef or dyke is the product of the final stage of the solidification of the granite, and the mineral contents have been derived directly from this rock. I conceive both the quartz and the acid granitic rock to have consolidated from an aqueo-igneous state of solution, or possibly fusion, and the presence of the latter at the margins of the dyke to be due to segregation during the process of consolidation. Almost the same theory is put forward by J. G. Spurr (the 18th Annual Report of the United States Geological Survey), to account for the origin of the gold quartz reefs of the Yukon Gold District, Alaska; where he observed a gradual passing over from dykes of pegmatite and aplite into typical gold quartz reefs. He summarises his theory as follows:—

“A molten magma may become segregated or differentiated into distinct portions by the successive precipitation of basic and the excretion of acid portions. With increasing amount of silica in the residue, there is also an increasing proportion of water over other materials, this water being in all cases in a high state of union with the other materials so long as these materials are unconsolidated; this state of union may be either chemical or physical. In the final residue the fluid becomes so aqueous and so siliceous, that it passes with no sharp division line into highly heated siliceous waters, which contain also small amounts of most of the other rock-forming elements, and among them gold. Gold occurs in the igneous rocks, but is uniformly disseminated, since it has no opportunity to segregate on account of the relative slight fluidity of these rocks during the process of solidification. In the final highly siliceous and highly aqueous residue, however, the fluid becomes

so attenuated that circulation becomes very free, and concentration of the rarer elements is permitted; so the gold is segregated often into pockets of considerable size, and in a like manner other materials are concentrated, generally independent of the concentration of the gold. It is also probable that the residual solution is, owing to physical or chemical conditions, or both, especially adapted to the retention of gold, and therefore is relatively richer in this metal than ordinary metalliferous solutions, and possibly more so than the molten magmas out of which the igneous rocks solidified. The theory is not intended to apply to the occurrence of gold in any other form than in the typical gold-quartz veins."

I think it very possible that the genesis of the copper lodes in the Scamander River copper-field may be explained by this theory.

As regards the economic value of the deposit under consideration, the occurrence is so unusual that it is impossible to venture on any conclusion as to its probable contents in the valuable metals. From a geological point of view it would be very interesting to see the deposit opened up, but as a mining venture I can only say that it would be purely speculative. If we accept Spurr's theory as to the deposition of the gold, the deposit is not likely to be highly gold-bearing, for, according to him, the segregation of the gold only takes place after the solution has become highly attenuated; and I think in this case the quartz has been deposited before a high state of attenuation had been attained.

DEPOSITS OF WOLFRAMITE SOUTH-WEST OF ST.
HELEN'S.

These deposits are situated about seven miles to the south west of St. Helens, in the same slate and sandstone country in which the deposits of copper already described occur, but here contact metamorphism is very marked. A massive belt of granite occurs about a mile to the north, crossing the country in an east and west direction, and from this belt other dykes of granite porphyry protrude into the country.

The Baden Powell Wolfram Co., No Liability.

Section 4916-93M. 80 acres. Quite a number of quartz veins carrying tungsten ore (wolframite) have been dis-

covered on this section, some of which strike north and south, and the others north-east and south-west. They are situated on the sides and crest of a bold spur which falls into a small creek, an affluent of the Scamander River.

Lode No. 1.—6 inches to 8 inches in thickness, striking north and south and dipping 80° to the west. Carries a fair percentage of wolframite, but, owing to its small size, is far from payable.

Lode No. 2.—Exposed in trench about four chains south-west of No. 1. Strike north-east and south-west. Dip 70° degrees to the west. About 12 inches in thickness. Carries wolfram freely through the stone.

Lode No. 3.—Situated about 3 chains to the west of No. 1. Strike north and south, dipping to the west. Width about 2 feet 6 inches. Carries a little wolfram.

Lode No. 4.—About half a chain to the west of No. 3. Strike east of north, from 15 inches to 2 feet 6 inches in thickness, but carries very little wolfram.

Lode No. 5.—Situated 3 chains to the south-west of No. 4, and very possibly a continuation of that lode. The strike is north-east and south-west, and the dip 80° to the west. The lode has been opened up along its course for over a chain. It is split up into two parts, with 6 feet of country in between. A little underhand stoping has been done on this reef, and about a ton of wolfram ore mined. The stope was full of water at the time of my visit, but some of the stone exposed carried a very fair percentage of metal. It appears to be very bunchy.

Lode No. 6.—This reef is exposed in a small trench, and appears to be about 18 inches in width. It is considerably broken up where exposed, and strike and dip were not determinable. Very little wolfram present.

Lode No. 7.—Situated 4 chains to the south of No. 5, strike north and south. Dip 85° degrees to the west. Carries very good wolfram, but the size of the vein is small, being only 6 inches in width.

From the above description it will be evident that nothing of a very payable character has yet been discovered on the property. Some of the veins are promising, but unfortunately those which carry the most satisfactory amounts of wolfram are unsatisfactory as to size. The wolfram occurs in moderate-sized crystals in the quartz.

No 2 ✓

None of the ore is rich enough to ship without careful dressing, and this could not be done economically by hand. However, the difference in specific gravity between wolframite and quartz being great, the ore could very easily be separated mechanically. It would require to be first crushed in a jaw-crusher, to say 1-inch cube, then treated on jigs, and the middle products further crushed in a ball-mill or other suitable crusher, and treated on a Wilfley table. Very little classification would be required. This would, however, entail a considerable outlay, and should not be entered upon until the actual contents in wolfram have been definitely ascertained. In order to do this more development work is necessary, the work done so far having been purely superficial. A couple of tunnels should be put in to cut the most promising of the veins, and they should then be driven on, and the stone obtained carefully stacked and sampled. I must, however, own to being doubtful as to the contents in wolfram being rich enough to pay the cost of mining and treatment, as most of the veins are very small.

Carson De Beers Wolfram Company, No Liability.

Sections 3516-93¹²¹¹⁶_M and 3517-93¹²¹¹⁶_M, each of 40 acres, and 470-93_M of 3 acres. This mine is situated south-east and adjoining the Baden Powell Mine, on a spur at the opposite side of the creek. Quite a number of small veins have been cut on this section, all carrying wolfram, but, unfortunately, as far as I could see, in quantities which are quite unpayable. The largest of these veins is situated on the southern slope of the hill where one 2 feet 6 inches, and another 2 feet in width, are exposed. They are both very poor in wolfram. I understand that about a ton of wolfram ore has been won and exported. This evidently occurred in bunches in the veins, as I could not find any place where wolfram was showing freely in the stone. In the north side of the hill a tunnel has been driven on a course of ^{south} ~~north~~ 30° east for a distance of 250 feet. Four formations containing small veins of quartz, varying in width from 2 inches up to 8 inches, were cut in the tunnel, and one of these is said to have contained nice bunches of wolfram, but nothing of a payable nature was struck. I cannot regard the results obtained as at all encouraging.

Sections 4382-93m.

40 acres. Charted in the name of Isaac Jacobs. This section is situated to the south of Carson De Beers Mine, and on a parallel spur. A number of large trenches or open cuts have been made up the side of the hill, exposing veins of quartz, carrying a little wolfram and molybdenite. They are all very small, varying from 3 inches up to 18 inches in width, and in none of them are the wolfram contents anything like payable. I cannot regard the work done on this section as having been judiciously carried out. The open cuts are of very much larger dimensions than the size of the veins warranted; and quite as much information could have been obtained with one-fourth of the expense, had more intelligence been brought to bear upon the direction of the operations. I do not think that anything of value has yet been discovered on the section.

ALLUVIAL DEPOSITS OF TIN AT THE SCAMANDER RIVER AND AT ST. HELENS.*The Scamander Tin and Gold Mining Company.*

J. Bass, Mine Manager. This company has been recently formed, with the object of treating, by the process of hydraulic mining, some extensive alluvial flats on the banks of the Scamander River, for tin and gold.

I regret that the manager was absent from the mine at the time of my visit, operations having been temporarily suspended. In his absence I was shown round by Mr. J. Bass, jun., who did everything in his power to assist me.

The first flat examined was that lying highest up the river. It is extensive in area, widening out within the sections held by the company from 10 chains to nearly half a mile. Several lines of prospect holes have been sunk, two of which extend nearly across the flat. The most southerly of these lines contains eight holes, and near the eastern end of the line a paddock 25 feet square has been stripped and some of the dirt treated by box-slucing. I was unable to learn what results had been obtained.

I regret that, with the exception of the wash exposed in the paddock, and also possibly present in the two holes on

either side of it, which were not tried, the results of dish prospects were most unsatisfactory. In each case bulk samples were taken of the wash exposed in the bottom of the prospect holes, except where the latter were fallen in or were full of water, in which cases the wash at the mouth of the hole was tried. From the six holes tested in this way, the best prospect obtained was 0.11 ounces of tin ore to the dish. This was taken from about 2 ft. 6 in. of wash in the fourth hole, counting from east to west. The prospects obtained from the other holes gave an average of only 0.07 ounces to the dish. The depth of wash in these holes varies from 2 feet up to 4 ft. 6 in., with an average of about 2 ft. 9 in.; but two of them have not reached bottom. After striking the wash the water became too heavy, and no more work was done; these have not been taken into account in the above estimate. The average depth of the overburden is about 4 feet.

In the paddock mentioned above the depth of the wash is from 3 to 4 feet, with one or two feet of overburden. Two bulk samples were washed from different parts of the face, yielding, practically, equal results, namely, half an ounce of tin to the dish. The holes on either side of the paddock were not tested; one of them had not reached bottom, and the other was quite close up to the paddock where bulk samples had been taken. The extent of this better class of wash was, therefore, not accurately determined. I was told that prospects ranging from one to two pounds of tin to the dish could be obtained from this paddock. My informant did not know the spot where this had been obtained, and we were unable to find it. Certainly, there is no considerable amount of wash which will carry this proportion of tin.

The second line of holes has been sunk a few chains to the north of the first. It consists of five holes. In three of these the depth of wash is from 4 to 5 feet. In the other two it is under one foot in thickness. The overburden would average 4 feet. The average prospect obtained from all the holes was again 0.07 ounces to the dish.

The third row of three holes is situated about 10 chains to the north of the second row. In one of these there is no wash present. In the other two there is 2 ft. 6 in. of wash, which yielded only .025 ounces of tin to the dish.

Several other holes have been sunk further north, but I tried no further prospects. The wash is not of promising appearance, and Mr. Bass informed me that the tin contents were no better than those already obtained.

South of the prospect holes already described, one block of ground has been worked by box-slucing. The worked ground is about three square chains in area, but the wash was evidently shallow. I have not been able to ascertain the results obtained.

From information supplied me by Mr. E. R. Spain, the legal manager, I gather that the company proposes to treat the gravels of this flat in bulk by the process of hydraulic mining. A water-race has already been surveyed, nine miles in length, to tap the Scamander River, and of this some 60 chains have already been cut. This is to have a capacity of 500 cubic feet of water per minute, and will give a head of 200 feet. The fall in the river being small, it is proposed to raise the tailings by means of a jet elevator. The estimated cost of this work is put down at £5000. I am extremely doubtful if the developments so far obtained warrant the expenditure proposed. Only in one place has payable wash been discovered on this flat, and, so far, its extent is unknown. It is certain that the greater part of the flat is of no practical value. Excluding the one patch of better-class wash which has been found, the rest of the wash will not average over one-tenth of an ounce to the dish. This is equivalent to five-eighths of a pound to the yard. Reckoning the tin as being worth £80 per ton, this would give a total value of about 5.4*d.* per yard. This sum has, however, to be divided by at least two to allow for the overburden, which, according to my tests, contains, practically, no tin. This gives a maximum gross value of 2.7*d.* per yard of wash to be shifted. In my opinion the ground could not be treated for anything like this sum. The wash is shallow, there is little fall for the tailings, and there would be a considerable amount of expense in removing the timber, which grows fairly luxuriantly all over the flat. The only question, therefore, which arises is, whether the run of richer wash which has been discovered in the southern portion of the flat is sufficiently extensive to warrant the carrying out of the work. It has been already remarked that its extent is, as yet, undetermined. It does not extend much further

to the west than the paddock already alluded to, as proved by the first line of holes. To the east its extent is, as yet, unknown, as neither of the two holes which were sunk in this direction reached bottom. If it extends in a northerly direction it must be narrow, for it has not been struck in any of the holes farther north. Towards the south it may extend for some distance, but here, also, it must be narrow. I do not think there is much probability of finding an extensive area of payable wash on this flat. The country around is composed of slates and sandstone, and is by no means typical tin country. It is true granite does occur some distance higher up the Scamander River, but we find very little granite in the wash, and it is certain that no extensive granitic area has suffered denudation in the watershed of the Scamander River.

The next flat on the river held by the company is situated about a mile to the south-east of that just described. It is small in area, but undoubtedly contains a lead of tin-bearing wash running through it. A paddock of about a square chain in area has already been worked at the top end of the lead. In the face, the wash is about 3 feet in depth, with 6 to 8 feet of overburden. A dish taken from near the bottom of this wash yielded 0.7 ounces of tin. I understand the ground was worked by the company, but I am not aware what results were obtained. The lead is, probably, about 7 chains in length, by, perhaps, two chains in width.

The third flat is situated about 60 chains west of the last. A good deal of prospecting has been done here, and has demonstrated the presence of a lead about 15 chains in length by one or two chains in width. The depth of the wash runs up to 10 feet. Bulk samples taken from the lead yielded prospects varying from one-tenth to one-third of an ounce to the dish. At either end of the lead the wash has been worked, but with what results I did not hear. It is possible that both this lead and the one higher up might be profitably worked by a party of working men; but I very much doubt if it will pay the company to work them. Certainly, the amount of wash is not sufficient to warrant any extensive hydraulic scheme being entered upon.

The company has applied for a road to be made from Ryan's farm along the Scamander River to its mine. There are no difficulties from an engineering point of view;

the road would follow approximately the course of the present pack-track, fording the river three times before reaching the upper sections. I do not think the construction of this road is justified at the present time; a pack-horse can be got almost anywhere through this country, and there is already a rough dray-road along the tops of the spurs by which two horses can draw a load of 15 cwt. The road, if constructed, would also serve Ryan's copper show, which is situated about two miles north-west of the Scamander Company's sections; but, I think, that in this case also the pack-track will serve all requirements for some time to come.

Tin Mining at St. Helens.

The majority of the alluvial tin-mining carried on up to the present in the St. Helens District is confined to the working of comparatively recent gravels and wash, on the top of, and in the vicinity of, what is known as Thureau's Deep Lead.

The tin in the present workings has been derived principally through the denudation of the older gravels of the lead, and these have derived their tin contents from the extensive granite area well known as containing many large deposits of tin ores, of which the Anchor Mine is the most conspicuous.

Thureau's Deep Lead has been carefully described and charted by Mr. A. Montgomery in 1893, and as very little has been learned about it since that date, it will be unnecessary for me to describe it in detail. The history of the lead is practically the same as that of several other similar leads in the Northern part of Tasmania, as for example the deep leads at Derby, Back Creek, &c.

It represents an ancient river channel, carved out probably in early Tertiary times by the George River, when the general level of the country was several hundred feet higher than it is at present. This we know from the fact that the gutter is now considerably below the level of the sea; how much below this level we do not know, but other old valleys cut out at the same time in the north and north-east of Tasmania have been shown to lie as much as 280 feet below sea-level, and it is probable that this one will prove nearly as deep. Since the old valley was cut out, however, there has been a long period of

subsidence, during which the river silted up its valleys, and the sea advanced inland. At the end of this period of subsidence, the land must have been very much lower than at present, for deposits of marine gravels, deposited during this period, we now find several hundred feet above sea level. After the subsidence, therefore, there came a period of elevation, which raised the country to its present level. I am of opinion that in this part of Tasmania the elevation has now ceased, and I think it possible that another period of subsidence has already begun.

Rivers often form very delicate indicators of the up and down movements of the earth's crust. This is based on the fact that every river is continually seeking its "base level," or the level at which it neither erodes nor deposits. If it is above its base level, it seeks it by cutting; if below it, it seeks it by building up by sedimentation. Suppose a country to rise gradually, and then to remain stationary. All the rivers would immediately increase their velocity and begin to cut; and the cutting process would go on until, owing to decreasing fall, the transporting power of the water would be exactly counterbalanced by the tendency of the sediment to deposit. Now the river begins to widen out its channel, and the longer the land remains stationary, the wider and flatter becomes the valley. But now, if subsidence commences, the velocity of the water will be still further checked, and the river will immediately commence to deposit, and this will continue until the base level is again reached.

In the St. Helens and Scamander Districts the fall of the rivers for many miles from their outlets is very small; it is true they are not depositing large quantities of sediment, but the fact that so much difficulty is experienced in getting rid of the tailings is sufficient evidence that they are not cutting.

The estuary of the Scamander River, which runs inland for a distance of five miles from the sea, may be due to subsidence, in which case it might be described as a drowned river valley; but it may also have been produced by the erosive action of the tides. Against the latter proposition is the presence of the sand-bar at the mouth of the river, which is only opened for one or two days in each year. It is, however, possible that the bar may not always have been here.

Coming back to the alluvial deposits at St. Helens, we have seen that there have been immense quantities of gravel deposited in the old valley of the George River. These deposits are evidently estuarine, though no fossils have been found which would indicate that they had been deposited in salt water. I shall refer to them as "estuarine gravels," in order to distinguish between the gravels of the deep lead proper, and younger gravels which have been deposited in fresh water, generally by running streams. They are principally composed of semi-water-worn particles, of whitish quartz, evidently derived from decayed granite, with sometimes kernels of this rock, and also numerous fragments of quartzite and slate. All the wash is tin-bearing, but, so far as is known, the estuarine gravels are unpayable. The latter extend inland from St. Helens for a distance of nearly six miles, and reach a maximum height above water-level of 265 feet. Their upper portions have been extensively denuded, and during this process the deposits of tin ore at present being worked have been accumulated. We may conveniently divide these deposits into the following three classes.

1st. *Concentrations in the surface soil.*—The gradual denudation of the low-grade stanniferous gravels naturally results in a concentration of the tin ore in the surface soil, for the heavier particles of tin gravitate into the creeks more slowly than the lighter particles of quartz. Large areas of this surface-wash have been already worked for tin, often under circumstances far from favourable, the wash having to be wheeled for considerable distances to water. The depth is, of course, shallow, varying from six inches to 18 inches; but the tin occurs from the grass-roots down. These deposits appear to be pretty well worked out now, though there are still a few men engaged upon them.

2nd. *Concentrations in the beds of present creeks.*—All the creeks flowing over the old lead contain important concentrations of tin ore. Many of these have been already worked, but, owing to the fact that the fall is slight, the miner, without capital, finds great difficulty in working them.

and there are still large quantities of wash untouched. Recent improvements in the machinery, and in the methods of working low-lying alluvial deposits, promise to have an important bearing on the payability of these deposits, and it is probable that within the next few years a large amount of ground, which defied the more primitive methods of box-sluicing, will be worked with satisfactory results.

3rd. *Concentrations in old gutters.*—In many places the surface of the estuarine gravels is furrowed by numerous old gutters, which have been filled up by wash, and are now often extremely difficult to locate. The character of the wash is, of course, essentially the same as that of the estuarine gravels, being derived directly from these, and, at the surface, they are often not appreciably richer in tin than the older wash; but, when the gutter has been reached, it has often proved to contain very valuable concentrations of tin ore. A number of these deposits are being worked at present, and it is highly probable that a great many more remain to be discovered. As soon as one gutter has been located others branching off from this are often found during the process of mining.

There is one other proposition which may, in the future, prove of greater importance than any of the deposits already described. I refer to the possible concentration of tin ore in the lower gravels of the deep lead. The estuarine gravels, which have filled up the old valley of the George River, all contain appreciable quantities of tin, not in sufficient quantities to be themselves payable, but still sufficient, when concentrated at the surface, to form very extensive deposits of payable wash. The question arises—Is it not possible that the old gutter may also contain concentrations of tin ore? The estuarine gravels were deposited during a period of subsidence, when the wash was laid down in wide layers and left undisturbed. There was no opportunity then for the tin to become concentrated, for this only takes place when the wash is being continually agitated and moved about; but during the

time the George River was cutting out its channel, and especially after it had reached its base-level and was widening its valley, then the tin had an opportunity of becoming concentrated in the bed of the river; for then the gravel would be continually agitated, and a natural sluicing process would be in operation. If, then, this same class of wash was transported by the river during this period—and we have every reason for believing it was—it is absolutely certain that accumulations of tin ore took place, and the amount of these accumulations would be proportional to the length of time which the river remained at its base-level before subsidence commenced. How long this period was we have no means at present of forming an opinion, but as other leads in Tasmania formed at the same time as this one have made important accumulations of ore in their lower gravels, it is probable that similar concentrations will be found here. I think, therefore, that there is every inducement to undertake the work of proving the value of the lower gravels. This will have to be done by shaft-sinking. The best plan would be to first locate the position of the gutter accurately by putting down a number of holes with the diamond-drill or the water-auger; then sink a main shaft in the solid granite and drive to cut the gutter at the proper level. Water would, probably, be heavy, and adequate pumping machinery would have to be provided.

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Royal Ruby Tin Mining Company, No Liability.

This company holds Sections 5079, 4822, 5075, 4189, 4838, 5122, and 5123, all 93m; total area, 110 acres. The sections are situated about two miles west of St. Helens, and follow the course of the Golden Fleece Rivulet for a distance of over a mile. The company proposes to work the gravels in the bed of this rivulet. In Section 5123 and 5122 the stream follows, approximately, the contact of the estuarine gravels of Thureau's Deep Lead and the granite. Through the other sections, the stream flows to the north of the lead, but higher up the stream follows the lead for a long distance. There has, therefore, been every opportunity for the stream to accumulate tin-bearing wash, by the denudation of the upper gravels of the lead. There appears to be some doubt as to whether some of the stream has not been

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already worked in former days by hand labour. This is difficult to determine at present, owing to the bed of the stream being covered by a layer of tailings from workings higher up the stream; and much of the ground is difficult to prospect, because it is impossible to sink holes in what may be expected to be the richest ground on account of water. The company has, however, satisfied itself that whether this be the case or not, there is a large amount of payable wash in the creek which it can treat; and it has shown its confidence in the claim and in the district by erecting a small plant driven by steam-power in order to work the ground.

At the time of my visit, the plant was being given a trial run, and everything appeared to be going smoothly. It consists of a gravel pump worked on the principle of the ordinary centrifugal pump, but with special liners which can be accurately adjusted to allow for the wear in the blades of the pump. The method of working is briefly as follows:—the pump is erected in a spot which commands as large an amount of wash as possible; a hole or sump is sunk by hand for the suction pipe, and the wash is then sluiced into this hole by streams of water, assisted by men with mattocks, forks, &c., and is elevated by the pump on to the tail-race, which is placed on a raised platform. In this way all the ground is worked which will gravitate into the sump, after which the pump must be removed to another place. In order that this operation may be carried on with a minimum of expense and delay, it is advisable to erect the pump and engine on a pontoon. When they have to be moved, it is then only necessary to let the water rise in the workings and float the pump into its new position close to the working face. Very little water is required, as the same may be used over and over again, and no get-away is wanted for the tailings, as they are deposited on the ground that has been already worked. As regards economy, the system, of course, cannot be compared with either that of hydraulic mining or dredging, but over hydraulic mining it has the advantages already mentioned of requiring little water and no fall or get-away for the tailings; and over dredging it has the advantage that the bottom can be effectively cleaned up, and that logs and boulders do not seriously interfere with the operation. Of course, if plenty of water at adequate

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pressure be available it may be utilised effectually in breaking down the wash, as in hydraulic mining, or, failing the latter, a second pump may be used to eject the water onto the working face through a nozzle.

The system is suitable for treating medium to high-grade wash on very flat ground, either with or without an abundant supply of water, the former, of course, being preferable. It seems particularly adapted for working much of the flat ground near St. Helens where sluicing water is often scarce, and ground water so abundant as to render its treatment by manual labour impossible.

In Victoria, 10 gravel pumps of similar construction to that employed at the Royal Ruby were at work during the year 1900, working a total of 285 weeks, and treating 452,283 yards of gold-bearing wash; this gives an average of 1587 cubic yards per week per pump. In addition to these, 15 port-runner gravel pumps were also employed, working a total of 588 weeks, and treating 2,861,093 yards of wash, or an average of 4866 cubic yards per week per pump. I am informed by Mr. J. Travis, the Secretary for Mines and Water Supply for Victoria, to whom I am indebted for the above information, that a full account of the system will appear in the next annual report of the Mines Department of that State, which will be published in about a month's time. The system has also been worked with success in New Zealand.

In the interests of the district it is to be hoped that the system will prove successful, as there is no doubt that there is a lot of ground of a similar nature to be worked. Unfortunately, the engine employed is hardly powerful enough for the work it has to do, but this should not prevent the company from proving the efficiency of the system. The company is to be complimented on the energy it has displayed in bringing the plant into operation.

Fern Tree Creek.

This is an affluent of the Golden Fleece Rivulet, about 3½ miles to the west of St. Helens. The run of wash, which is at present being worked by Patterson Brothers, runs, approximately, parallel to the creek. It has an overburden of six or eight feet of loam and sand, and an average thickness of three feet of payable wash, which goes up to six or eight feet in the centre of the gutter.

Several prospects were washed from the latter with excellent results. The ground is very flat, and all of it has to be dug out and removed by wheelbarrows. That, under these circumstances, the ground can be made to pay, speaks well for the tin contents. A limited supply of water for sluicing purposes is obtained from the Golden Fleece Rivulet. North of Patterson Bros.' claim, Riley and party are working some good ground on the same lead. A paddock which had just been taken out before my visit, 19 feet by 10 feet in area, yielded two bags and 20 lbs. of tin. The ore is of the finest quality, being principally composed of Ruby Tin. South of Pattersons' workings the lead is said to have been traced for a long distance, but owing to the presence of ground water it is difficult to prospect. The ground seems admirably adapted to the gravel-pump system of mining ; but before any such plant should be erected it would be advisable to make sure of the presence of sufficient quantities of wash to warrant the erection of the machinery. The plant is an expensive one, and the undertaking should not be entered upon without careful investigation in this direction. I am told that south of the present workings above Russell's Dam, about two miles of the present creek has been worked in former years with excellent results. If this is the case, there is a strong probability of this lead also continuing payable for a long distance above the present workings.

Saxelby Creek.

This is another affluent of the Golden Fleece Rivulet, about five miles west of St. Helens, where C. E. Russell and party are working a promising run of ground. The wash is about seven deep, and has little or no overburden, though the upper layers of wash are poor. A dish washed from the lower portion gave a prospect of nearly 11 ozs. of tin-ore. Mr. Russell tells me that the ground they work averages 3 lbs. to the yard, taken all through. The water used for sluicing and mining purposes is brought from one of the tributaries of the Scamander River along a race eight miles in length. With their present arrangements the party is only using a fall of 50 feet for working the small nozzle which they use for breaking down the wash, but Mr. Russell tells me that his race commands 120 feet more fall than they are at present

using. He also tells me that by cutting another six miles of race another branch of the Scamander River can be intersected, from which an abundant supply of water can be obtained. North of their present workings there is a fine face of wash over 14 feet in height, from which some nice prospects of tin were washed; some of this has been lately worked with excellent results, but work had to be suspended through shortage of water. This ground has the exceptional advantage, in this district, of having a good fall, so that there would be no trouble in getting rid of the tailings. On the whole, there appears to be a large amount of wash available, and provided that an adequate supply of water is obtainable there should be a good opportunity for a strong company to work the ground by hydraulic mining. Before entering upon the undertaking, however, the amount of payable wash should be definitely ascertained. This would involve a survey of the ground and a careful estimation of the tin contents of the wash.

*Thureau's Deep Lead Tin Mining Company,
No Liability.*

B. H. Whittle, Manager. The company holds Sections 5323-93M, 1999-91M, 4284-93M, 1473-87M, 5279-93M, and 251-87M; in all, 120 acres. The sections are situated about five miles W.N.W. of St. Helens, on the western portion of the deep lead. The ground, at present, being worked by a party of Chinese tributors, consists of filled-in fresh water gutters on the surface of the old lead. Quite a number of these have been found and followed up in the process of mining, though they are very difficult to locate by surface prospecting. The depth of the working face varies from 10 to 20 feet, and that of the payable wash from 1 to 10 feet. Mr. Whittle informs me that, taken all through, the ground will average 2 lbs. of tin ore to the yard of dirt. The water is, at present, taken from Powers' Rivulet. Six heads only are available, but the company is engaged in renovating the old race, and constructing 15 chains of new fluming, when it is expected that 20 head will be available during the winter months, and as the new fluming is at a higher level a much larger area of ground will be commanded. A large amount of tin has evidently

been taken out of this ground, and it is probable that much more still remains.

Several attempts have been made on these sections to bottom the deep lead, and to ascertain the value of the gravels in the lower portions of the lead, but, so far, without success. Quite a number of shafts were put down in the wash to depths of from 30 to 60 feet, only one of which touched bed-rock, and this one evidently far away from the gutter. In each case the work had to be abandoned, owing to the influx of water proving too strong to be dealt with by hand labour. These shafts proved the wash to be stanniferous throughout, some of the seams going as high as $\frac{1}{4}$ ounce to the dish, but nothing payable was struck. It is evident that if the lead is to be found, operations will have to be carried on in a more systematic manner than has yet been attempted. Pumping machinery will certainly be required, and it would be most advisable to locate the gutter first by boring before the main shaft is sunk.

Fenton's Mine.

Mr. W. Fenton is working an excellent run of wash to the north-west of Thureau's Deep Lead Company. The depth of his face is at least 20 feet, and he tells me that the wash will average 4 lbs. to the yard. The lead is a fresh-water deposit on top of the old estuarine gravels. He is unfortunate in having to pay a heavy royalty for his water.

The Upper Ruby.

The property known as the Upper Ruby consists of a number of sections charted in the name of A. Deédes, A. Lee, and George Briggs, situated about a mile to the south of Thureau's Deep Lead Company's sections, and comprises a total area of 420 acres. The ground is held by a strong syndicate, which proposes to bring in a large supply of water from the Groom and George rivers. The scheme involves the cutting of 34 miles of race, and the erection of $2\frac{1}{4}$ miles of syphon, at an estimated cost of £15,000. The pressure available is stated to be 370 feet. Unfortunately, I was unable to make a thorough examination of the property, there being no one on the mine to show me round. The surface gravels and soil have already been largely worked for tin, and there is a

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probability that fresh-water gutters, such as occur at Fenton's, and Thureau's Deep Lead Company's sections, will also be found here. The syndicate, however, evidently proposes to work the old estuarine gravels in bulk by hydraulic mining; and as it will have an abundant supply of water at an efficient working pressure, it will certainly be able to treat the gravel at a very low cost. There is, therefore, every hope that the venture will turn out a success. I was unable to ascertain what investigations had been made as to determining the tin contents of the wash. The quantity available is very large.

The Rose Tin Company, Limited.

Henry Lansdale, Mine Manager. This company was formed in London to work the sands on the Southern beach of George's Bay for tin, by means of dredging. The company holds a number of sections along the beach to low-water mark, and several others embracing extensive sandy flats in the vicinity. The Manager informed me that he had been greatly disappointed with the results obtained so far. A great number of prospect holes had been put down along the beach and over the flats, but the great majority of these only contain a few colours of tin to the dish. In one place only is the beach sand anything like payable, so far as has yet been proved, and here, Mr. Lansdell estimates it to carry 1 1/2 lbs. to the yard. Unfortunately, at this point the wash is very shallow. The company has purchased a Priestman Dredge, with the object of prospecting the sands below high-water mark, and at the time of my visit this was in process of erection. I fear there is little chance of anything payable being discovered.

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

GEORGE A. WALLER,
Assistant Government Geologist

W. H. WALLACE, *Esq.*,
Secretary for Mines, Hobart.