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VARIOUS

REPORTS

ON

ST. EUGENE MINE

MOYIE, B.C.

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C O P Y

R E P O R T

ST. EUGENE MINING CORPORATION LIMITED, NPL.

MOYIE, B. C.

NOVEMBER, 1939
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ST. EUGENE MINING CORPORATION LIMITED.

MOYIE, BRITISH COLUMBIA

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MOYIE, BRITISH COLUMBIA

INTRODUCTION:

The property of the St. Eugene Mining Corporation Limited is located at Moyie, East Kootenay District, British Columbia. It is a consolidation of the St. Eugene, Aurora, Guindon and Cambrian groups with some additional newly staked claims.

This report deals with observations and conclusions made following a geological examination of the surface of the surrounding area and also a very limited examination of the underground geology due to the inaccessibility of almost all the mine workings. The work was completed during the summer of 1939 using a plane table and stadia for control of survey and topography.

The major ore bodies were found on the property of the St. Eugene mine which is reported to have produced over 1,000,000 tons of silver-lead ore having a value over $10,000,000.00. A great part of the ore was hand-cobbed to remove the then discarded zinc mineral sphalerite. Very limited exploration of the Aurora fractures yielded a small orebody which is claimed to have produced 4,000 tons of high grade silver-lead ore.

SUMMARY:

The detailed geological survey shows that the strata have been warped into a gentle anticline which has undergone

later dislocation, the chief of these being a north-east south-west thrust fault. To this inferred fault can be related the known fracture system and ore bodies. This fault parallels the strike of the strata on the west flank of the anticline but is a few degrees steeper in dip. It is believed that the fault movement on crossing the anticlinal axis was in part transmitted into fractures parallel to the strike of the strata on the east flank of the anticline. These are the St. Eugene ore fractures and are developed on the foot wall of the fault. The Aurora and Guindon fractures eree formed on the hanging wall of the fault.

Other fractures would be expected to exist in the intervening ground as well as a crushed and fractured zone near the fault when a suitable host rock is present.

A line drawn along the bottom of the ore bodies is equidistant at all points to the intersection of the ore fractures and the fault which strongly suggests the fault is the channelway for the ore solutions. The parallelism of the line with the slope of the hill is largely coincidental.

The formation of orebodies is largely dependent upon permeability of the host rock and this would seem to be controlled by structural factors. Of these the ones of paramount importance are cross folds and drag folds, faulting, jointing and undulations in the attitude of the strata. Ore bodies do not seem to occur where the fracture is of a simple type passing through otherwise undisturbed rock.

The rock type is of importance but only in so far

as it controls the reaction of the rock to external stress. Massive thick-bedded variaties tend to permit open cavities and to develop minute fracturing, allowing freer movement of the solutions and greater surface area in contact with solutions. In general, the thick-bedded members contain more lime and magnesia and may to that extent increase their replaceability. The thin-bedded more argillaceous types shear more readily producing a gougy fracture which acts as a barrier to solutions.

CONCLUSIONS:

Assuming that the theory set forth herein is correct the chances of a successful exploration program are considerably enhanced. It is thought that good ore bodies should have been developed in the vicinity of the intersection of the fault and the St. Eugene ore fractures. Likewise the shattering would have been much more intense near the juncture of the Aurora fracture and fault. There is a reasonable possibility that other unknown fractures and shattered zones will be found in the ground between the St. Eugene and Aurora.

The search for new ore bodies resolved itself into five distinct fields of attack:

(1) The detection of undiscovered ore bodies in the old workings. The majority of these are likely to be small and defray little more than the cost of exploitations; especially is this the case in the north vein. The south vein is more promising as it has been explored in a limited way only.

(2) The investigation of the St. Eugene fractures in the neighbourhood of the main fault below the argillite group.

(3) If ore bodies exist associated with the main fault in the intervening ground between the St. Eugene and the Aurora mines; their detection can best be made by a series of holes drilled from the ice.

(4) The Aurora and Guindon mines are near the upper limits of the favourable rock member in which the Moyie and Lake Shore ore shoots were located. We can reasonably expect that the pre-requisite conditions for ore development will greatly improve in these fractures along their projection downwards and southwards as they come closer and closer to the main fault. This favourable rock type will be found for 1,100 feet below the Aurora ore body. This block of ground offers the greatest possibilities with the least expenditure and therefore preliminary exploration should be concentrated here.

(5) The possibility of finding an ore body of the Sullivan type is thought to be somewhat increased. The most promising ground in which ore of this type would be expected to be found is on the west flank of the anticline in the minutely fractured wall of a strike fault. The inferred fault is of the strike variety but is thought to be a few degrees steeper than the dip of the strata. The information derived from a preliminary drilling campaign on the Aurora ground may support this inference; in which case the drilling program should be extended to adequately investigate the area.

RECOMMENDATIONS:

The search for ore deposits should be initiated by exploration with a diamond drill. This should be undertaken with two points in view. First: Immediate location of exist-

ing ore bodies, if any, along the continuation of known fracture systems. The most profitable section should be where the fractures impings on the main fault. Second; extension of program 1 to the vicinity of inferred NE-SW fault to explore the physical condition of, and possible development of ore in this fracture.

(1) This program would be the best carried out on the claims Aurora, Mabelle and Guindon for the following reasons:

a) Exploration of the St. Eugene fractures will require deep drilling- 1,000' plus - to intersect the fractures in the most favourable ground.

b) Favourable rock exists for 1100 feet below the Aurora #2 tunnel and this is the same member which contained the ore bodies in the St. Eugene Mine between the 1300 foot level and the 2000 foot level.

c) Since exploration for the continuation of the St. Eugene fractures would necessitate working near the boundary of the property and as this may be valuable ground, it should be acquired before any exploration is carried out in that vicinity.

The drilling campaign to be followed will be changed as results dictate. The target at the commencement of the drilling is threefold:

a) Exploration of the ground between the Aurora and Guindon fractures for parallel fractures and the intersection of their projections in a southeast direction.

b) Intersection of the N-S Guindon shears (these shears cut across the fracture in the drift and at these points the fracture carries galena; their continuation would bring them east

of the mouth of the Aurora #1 tunnel).

c) Exploration of the E-W pyrrhotite breccia zone which carries very low galena in the Aurora #2 tunnel.

The conditions necessary for ore development are likely to be greatly improved as the above fractures and shears reach the ground near the fault so that the work should be concentrated in that area.

The program outlined above will indicate the potential value of this ground and will require 4,000 feet of diamond drilling.

(2) Investigation by drilling of the section of ground traversed by the inferred NE-SW fault. The structural condition of the rock and ore possibilities can be determined with another 2000 feet of diamond drilling.

If the theory of ore formation is upheld by this preliminary drilling, the fault should be further protected along its strike previous to further exploration.

GEOLOGY: LITHOLOGY:

The Aldridge formation in the immediate vicinity of Lower Moyie Lake has been subdivided into four main lithological types. These are strictly arbitrary distinctions the two end types and are dependent upon increasing or decreasing argillaceous content.

1) Thick-bedded argillaceous quartzite: A fairly pure type of quartzite with beds ranging from 4 inches to 3 feet in thickness; generally white to light tan in colour but containing dark grey types; other impurities are lime and magnesia carbonates with minor felspathic material.

In part thin-bedded

2) Thin-bedded argillaceous quartzite: Increasing argillaceous content producing a medium to dark grey type with thickness of beds ranging from 1 inch to 4 inches; the percentage of carbonates much less than in the thick-bedded varieties. In part argillite.

3) Argillites; Dark grey to black in colour with beds less than 1 inch in thickness and slate-like.

4) Arenaceous argillite: This is a distinctive type with alternating beds of argillite and quartzite. The individual beds are less than 1/4 of an inch in thickness.

Distribution of Rock Types:

The distribution of the foregoing types permits four general divisions of the Aldridge formation in the neighborhood of Moyie.

St. Eugene Quartzites: These occur above the 900 foot level and are predominently of the thin-bedded variety. The St. Eugene ore shoots are contained entirely within this member.

Moyie Quartzites: These occur between the 900 foot level and the 2100 foot level and are largely of the massive thick-bedded type with some dolomitic variations. The Moyie and Lake Shote shoots are within this member.

Argillite Group: Projection of this group from surface outcrops places it from the 2100 foot level to just below the bottom of the shaft.

Road Quartzites: This member is similar to the Moyie quartzites and extends for many hundreds of feet, its upper limit being the Argillite Group. As with the other quartzite

groups this member contains minor bands of thin-bedded quartzites.

The St. Eugene quartzites and the Moyie quartzites together make up the St. Eugene Quartzite of Kerr while the Argillite group corresponds to his Upper Argillite member.

RELATION OF ROCK TYPE TO ORE DEVELOPMENT:

It is believed that the rock type plays an important part in the development of ore bodies but this part is largely of a physical rather than a chemical nature. It is reasonable to believe that the massive more rigid types will under the same stress develop open fractures while the more argillaceous beds will tend to form tight gougy shears thus decreasing the surface area in contact with the mineralizing solutions.

The thick-bedded, coarser and more massive argillaceous quartzites are therefore the most favourable types, other factors being equal, in which to find new ore bodies.

INTRUSIVES:

No large intrusive body is known to occur in the immediate area. Two diorite dikes are present near the eastern limits of the ore bodies. These are parallel in the ore region but rapidly converge toward the south. They are pre-ore in age having been offset to a considerable extent by the ore fractures.

STRUCTURAL GEOLOGY:

Folding: The Aldridge formation at Moyie has been warped into a gentle asymetric anticline with its axial plane trending N 19 deg. E and plunging gently northward at 10 (plus minus) 2 deg. Projection of the axial plane places it 600 feet west of the shaft.

This anticline has undergone later folding and faulting. The subsidiary folds are well exposed near the south end of the lake and these trend N 2 deg. W with a gentle pitch northward of 6-8 degrees. This secondary folding diminishes in intensity toward the north but again increases in strength near the St. Eugene ore fractures where the strata shows much cross warping and folding. These seem to be largely a preliminary to faulting and formation of ore fractures and also the contemporaneous dragging associated with the faults.

Joints:

The jointing is considered to be related to two periods of deformation and it is much more intense in the ore bearing district where they have played an important role. Especially is this noticeable in the St. Eugene shoots which in the majority of cases follow joint planes, the ore bodies frequently offsetting from one joint to another. This perhaps explains the development of ore bodies in the less favourable thin-bedded sediments.

Faults: The faulting in the area has occurred in three general directions. The ore fractures strike N 55° W and dip steeply south and are of the normal type. Thrust faults trend N 50° E and dip flatly north. Both these types are pre-diorite and both are believed to be pre-ore in age. Post-ore faults in a general north-south direction are common but those have only a small displacement.

The ore bodies are intimately associated with faulting, indeed the north, south and parallel veins are normal faults which dip between 65° - 70° south and trend in general N 55° W.

All observers agree that the north and south vein fractures converge downwards and towards Moyie Lake. The cross fractures or so-called avenue fractures are developed in that part of the fracture area where the two main fractures come sufficiently close together to permit the shattering of the intervening rock. This shattering should become more intense as the veins are explored westerly assuming an equally responsible host rock. The great irregularity of the avenue fractures makes it difficult to picture other causes of their development.

A prominent fault which offsets the diorite dike exists south of the ore zone. This fault strikes N 50° E and has a dip of 35° to the north. A number of others of small size with the same general attitude were located. It is inferred that a prominent one of this type occurs about 1200 feet north of the shaft and that it played an important role in ore development. This fault is referred to as the main fault. The following evidence supports its existence:

1. On the west side of the lake certain key horizons are offset and indicate fault movement along the valley.
2. Offsetting of the same beds on the east side of the lake is indicated but ambiguous results are obtained due to the general disturbance of the strata and the resulting uncertainty of average strike determination.
3. In the vicinity through which the fault is thought to traverse the strata are quite badly disturbed.
4. The presence of parallel faulting.
5. Fault occupies a valley on both sides of the lake.

SIGNIFICANCE OF INFERRED FAULT:

Kerr previously pointed out the apparent bottoming of the ore in a plane roughly parallel to the slope of the hillside and suggested that if this downward limit actually existed it was in all probability due to the fracturing.

Assuming a dip for the inferred fault similar to that of the parallel faults, is, 35° north, it is possible to advance an explanation for this bottoming.

The line drawn along the bottom of the ore bodies is roughly equidistant at all points with the intersection of the St. Eugene fractures and the main fault. It is thought that the main fault is the source of the ore solutions, and the St. Eugene fractures are of a subsidiary nature which have undergone fracture filling and replacement dependent upon two controls; the intensity of the secondary dislocation and the normal distance from the plane of the main fault.

RELATIVE AGE OF STRUCTURAL FEATURES:

1) Development of the major anticline.
2) Fracturing and intrusion of the diorite dikes.
3) Stresses which produced faults trending N 50° E. with contemporaneous development of secondary folds and ore fractures.
4) Fracture filling and replacement by ore solutions.
5) Final adjustments by north-south faulting.

Schofield believes that the ore bodies are related to the Kootenay granite and he places the dike intrusions as post-granite. Since the ore is post-diorite we must consider the

intrusions and ore solutions as co-magmatic in origin but each belonging to a successive period of differentiation.

STRUCTURAL CONTROL IN ORE FORMATION:

It is thought that the development of ore bodies is almost entirely controlled by geologic structure and that this is in part dependent upon the physical character of the host rock.

St. Eugene Shoots: These shoots occur at the eastern limits of the north vein where the movement has been largely dissipated into the existing joint system. The ore shoots feather out here although the fracturing continues a short distance farther. Mineralization took place here in open cavities as indicated by the complete development of faces on quartz crystals suggesting that tensional forces were operative. The north side of the fractures is offset towards the east and measurements on the dike show a horizontal displacement of about 150 feet.

Moyie Shoots:

The strata in the vicinity of these shoots has undergone quite intensive shattering and folding with the footwall being downwarped over a wide area while the hanging wall is bent upwards. The fracturing in this area is more intensive with many shatter zones but relatively little gouge developed. The host rock has a higher percentage of carbonates than is usual.

Lake Shore Shoots: The Lake Shore Shoots are developed in the zone where the two fractures have come sufficiently close together to permit the shattering of the intervening rock. This may be due in part to the jumping across of the fracturing from the south vein to the north vein. In any case it seems to be controlled by the proximity of the two main fractures. It is reason-

able to think that this cross fracturing would increase in intensity as the fractures are followed northwesterly. The juncture of the north and south vein with the main fault below the argillite group is therefore very promising prospecting ground.

J.G.Gwillim examined the mine at a period when all the workings were accessible and he summarized his observations as follows:

1) A remarkably regular country rock outside the wedge between the main and south veins.
2) A subsidiary dislocation of the rocks, resulting in steeper dips, parallel planes, avenue fractures, broken zones and areas, sheared zones and areas.
3) An association of ore bodies with this subsidiary dislocation.
4) An absence of ore bodies where the vein matter is comminuted or sheared fracture passing through otherwise undisturbed rocks.

Placing, however, most dependence upon physical rather than chemical peculiarities, one would expect to meet ore bodies where the coarser rocks show signs of considerable deflection from their regular course, for such deflections in such rocks must cause open fractures unless the pressure is too great to allow them.

The development of ore in the Aurora mine is dependent upon folding in the fracture zone, ore being developed where the dip of the fracture is reversing. Mineralization of the Guindon fracture is connected with cross shearing.

In conclusion: Ore development is dependent upon per-

meability of the host rock. This permeability is controlled by numerous factors; faults, joints, cross fractures, composition and physical character of the host rock, drag folds and other dislocations.

DEVELOPMENT OF THE FRACTURE SYSTEM:

The following process appears to be well supported by all the evidence now available.

A thrust fault originating by pressure from the northwest crosses the anticlinal fold about 1200 feet north of the shaft. Its strike is approximately parallel to the strike of the strata on the west flank of the anticline but with presumably a somewhat steeper dip. On crossing the anticlinal axis the fault is about at right angles to the strike of the strata on the east flank. Under this condition the fault movement is in part disrupted and fracturing and shearing have taken place parallel to the strike of the strata on the east flank of the anticline. The intensity of this subsidiary dislocation is controlled by its distance from the parent fault. Tensional forces being predominant in these subsidiary fractures the resulting movement is that of normal faulting with the south side moving down in relation to the north side.

It is not unreasonable to suppose that fractured and shattered zones are well developed in the rock adjacent to the main fault; especially so where the known ore fractures, if projected, impinge on the main fault.

POSSIBILITY OF FINDING AN ORE BODY OF THE SULLIVAN TYPE:

If an ore body of this type exists, it is more

likely to have been developed on the west flank of the anticline where thrust faulting parallel the strata has minutely fractured the rock, causing high permeability and consequent replacement with ore minerals. If mineralization is of the Sullivan type we would expect a high pyrrhotite content. The existence in the Aurora mine of a breccia largely cemented with pyrrhotite medium quartz and very low galena may indicate a duplication at depth of the Sullivan type of mineralization. The percentage of pyrrhotite in the Aurora breccia is excessively high in comparison to that found in the St. Eugene ore fractures. Preliminary exploration by drilling at depth of the ore bearing fractures on the west side of the lake may throw further light on the possible existence of an ore body of this type.

COPY

ST. EUGENE EXTENSION MINES LIMITED

MOYIE, BRITISH COLUMBIA

November, 1937.

Dr. Forrest A. Kerr.

ST. EUGENE EXTENSION MINES LIMITED

MOYIE, BRITISH COLUMBIA

C O N T E N T S

ST. EUGENE EXTENSION MINES LIMITED

MOYIE, BRITISH COLUMBIA

INTRODUCTION:

The St. Eugene Extension Mines are located on Moyie Lake, East Kootenay District, Southeastern British Columbia. The property as it now stands represents a consolidation of the St. Eugene on the east side of the lake, the Aurora and Guindon properties on the west side, and the area under the lake between these. The St. Eugene mine, with over 19 miles of workings, prior to 1914 produced over 1,000,000 tons of silver-lead ore with a value of over $10,000,000. There was a further small production in later years by leasers, and a very substantial recovery in silver, lead, zinc and gold (?) from re-treatment of tailings. The Aurora produced a small quantity (4,000 ? tons) of high grade lead-zinc ore. Working conditions are ideal at the St. Eugene mine. Descriptions of the plant, etc. have already been supplied by Mr. S.S.Sexton, the Mine Manager.

At present the old St. Eugene mine is being dewatered with the purpose of initiating a search for more ore. A number of reports on the property suggest that drifting along the St. Eugene veins under the lake will lead to the Aurora vein and should encounter more ore bodies en route. Unfortunately much of the information in these reports is incorrect, notably the belief that the St. Eugene veins if projected link up with the Aurora veins.

SUMMARY:

The mineralization at the St. Eugene, Aurora and Guindon mines is similar and probably came from the same source. The mineralization is also similar to that at the Sullivan mine, which from a small part of its ore bodies has produced over 21,000,000 tons. The mineralization is high temperature, deep seated, and shows no mineralogical change at depth that would suggest that it might be limited to a narrow vertical zone. The amount of ore in the Sullivan and St.Eugene mines, as well as the distribution in other nearby mines, suggests an abundant supply of mineralizing solutions, so that it is a reasonable hope, given favourable local conditions, that large quantities of ore still exist in the St. Eugene Extension ground.

It has been found that the character of the rocks, which are well bedded sediments, is one factor controlling the distribution of mineral deposits. The structure has been worked out so that in a general way the character and position of the favourable rocks can be indicated. It is believed that more detailed studies can delimit favourable bands or beds of rock with considerable precision.

The distribution and nature of fractures in the rock is a second controlling factor; where a favourable type of fracture intersects a favourable type of bed an ore body is likely to occur. The character of the fracture systems is clearly indicated in the old workings, and is comparable to those developed in splitting wood with a twisted grain; the break follows one main line in places, then jumps to another

with cross breaks and parallel breaks in between. Where ground is opened up by mining operations or tested by drilling, giving some information of the general system, the position of unknown fractures can be postulated, but in areas such as that under the lake the positions cannot be postulated with any more accuracy than can the cross breaks in splitting the wood with twisted grain, except that presumably at the Aurora and Guindon to the west and the St. Eugene to the east the position of the main breaks is known, and any other fractures would lie in between (See Figure 4).

In the old workings there are great lengths of barren fractures or shattered zones which in places are of impressive widths. It was characteristic that in following these, regardless of whether they were wide or insignificant, the workings would suddenly enter wide deposits. Equally abruptly, wide deposits ended. A number of these abrupt changes were observed to be along bedding planes. The wide parts are considered to be replacement bodies in favourable beds. Narrow parts in places are merely due to fissure filling in beds unfavourable for replacement. Barren sections along the fractures are, therefore, largely due to the absence of replaceable rock, or to tightness of the fracture, preventing passage of the mineralizing solutions.

CONCLUSIONS:

The St. Eugene Extension property has considerable merit, but chances of success will depend largely on geological guidance. The large expenditure already made, the fact that the mine is nearly dewatered (water just above the 2100 level

on November 5th), and the merit of the property would seem to warrant further expenditures in the search for ore.

The possibilities of the property are as follows:

1. The chances of finding more ore in the old workings of the St. Eugene mine. These would be -

a) Small inter-level undiscovered bodies, as the levels have been well tested by mine workings and horizontal drill holes.

b) Extensions of mined bodies which were left because of high zinc content.

c) Deposits too low grade to be mined with the less efficient mining and milling methods of early 20th century years. Note:- A very substantial profit was secured from re-treatment of the old tailings, so that the difference between profitable ore then and now is considerable. Furthermore, it is reported that picking of the dumps was profitable, and an attempt was made to mill the dump material.

See Section on SEARCH FOR ORE IN THE OLD WORKINGS, p.19.

No consideration here is given to the levels above 1800. A blue print accompanying this report and prepared in 1929 indicates certain possibilities there. Probably there are others.

2. The lower workings of the St. Eugene mine, which yielded poor results, are in a series largely of argillites which are believed to be unfavourable for the formation of ore bodies. Below these is a series of quartzites similar to the St. Eugene quartzites and believed to be favourable (See Figures 5 and 7), so that the fractures in these have a good chance of carrying ore bodies.

3. The Aurora and Guindon mines are in the base of the favourable part of the St. Eugene quartzites. There may be other fractures and veins between these, and possibly other deposits deeper within the hill. Other deposits are also reported farther north on the west side of the valley. It is probably more than 600 feet below the Aurora before the fractures are again in favourable rock.

4. Between the Aurora, Guindon and St. Eugene mines there may be a series of parallel and cross fractures (See Figure 4). There would seem to be a very good chance of this, because in this section the fractures, after paralleling the strike of the rocks on the east side of the lake, cut across the axis of the Moyie anticline and run oblique to the strike. This change of condition is likely to cause a change in fracturing. Furthermore, the similarity of fracturing and mineralization on both sides of the lake suggests close relationship.

If this system does exist under the lake it might be expected to carry deposits in the narrow band of favourable St. Eugene quartzites and in the Road quartzites. The St. Eugene quartzites, however, thin out rapidly toward the south. The Road quartzites are successively higher and nearer the surface toward the south.

5. The south vein of the St. Eugene system to the east has not been opened up to any great extent. The fracture system is reported to continue 2 miles east to the Society Girl, which was also a producer. It is probable that, if success is met with in a program at Moyie Lake, other opportunities to apply geology in the search for ore lie to the east on the south fissure and elsewhere.

6. There is a possibility of the existence of a large ore body of the Sullivan type in the axis of the anticline in the upper part of the Road quartzite. Some of these rocks appear to be susceptible to replacement and, if they are sufficiently so, which may be determinable from petrographic studies, there is a very good chance that they are extensively replaced in the anticline in a similar manner to the Sullivan body, since the overlying argillites may have restricted upward movement of solutions.

RECOMMENDATIONS:

1. To secure ore quickly the best hope is in the old workings. The chief need, then, is to have the mine workings adequately mapped and studied in detail. The raises, winzes, and stopes which are at present inaccessible are likely to yield the most information. Careful chemical and mineralogical studies of the rocks will be necessary to determine accurately the favourable beds. All of this work is relatively simple, but there is much to be done. It could be done cheaply by a mine geologist at $200. a month, with a limited amount of assistance for cleaning up, ladder construction, etc. This would be followed by diamond drilling, mostly of short holes.

2. To embark on a major exploration plan involving considerable expenditure.

Geological study of the workings below 2000, now inaccessible, to establish the correctness of the deductions made herein and, if established, to locate accurately the top of the Road quartzites. Then a study of the fractures to determine the relative strength of the main, south and other parallel fractures,

and also any tendency toward cross fracturing.

Having completed this the quartzite series should be tested by drilling in such a way as to intersect it where traversed by strong parallel fractures near cross fractures or by strong cross fractures. Further, it would be advisable to do the drilling so as to penetrate the quartzite above the projection of the line drawn along the base of known ore bodies (see Figure 5).

Any drifting under the lake is likely to be more profitable along the south vein, thence swinging southerly toward the Aurora, as results dictate.

3. Further detailed study of the Aurora and Guindon mines after opening up of inaccessible parts. Careful projection of the favourable beds that yielded ore in the Aurora, and then drilling of the zone between the Aurora and Guindon, if possible along the beds, in the search for other parallel fractures or avenues.

GENERAL GEOLOGY:

The general geology is shown in Figure 2 and the detailed geology in Figure 3. The deposits are all in the Aldridge series. A considerable thickness of the series lies above the highest beds containing deposits, and probably 10,000 feet like below the lowest deposits. There are no known intrusives in the vicinity other than very rare dikes and sills.

The Aldridge series is mainly quartzite. Large parts are argillaceous, and locally there are argillites.

In the area of the deposits the series is subdivided as follows:

St. Eugene quartzite	-	Mainly quartzite. Some is argillaceous, dolomitic and calcareous.
Upper Group of Argillites	-	much argillite and argillaceous quartzite with some bands of quartzite.
Road Quartzite	-	similar to St.Eugene quartzite.
Lower Group of Argillites	-	not exposed.
Quartzite	-	quartzite and argillaceous quartzite.

The St. Eugene group is made up mainly of massive hard quartzites which form steep, rugged slopes with numerous cliffs. They stand well in mine workings, and on fracturing commonly shatter and show relatively little gouge. Some of the quartzites are hard and glassy and appear to be largely quartz. There are also numerous beds of granular material which, though largely quartz, contains appreciable and in places abundant calcite and dolomite. Some of these beds, notably in the lower part of the group, weather pitted. The granular quartzites are generally of fairly light colour, scratch and crumble readily and have an appearance somewhat like calcareous sandstone. Other beds in the series are argillaceous. These are commonly fine grained or dense, and are usually dark slaty gray.

The argillite group is more finely bedded, softer, and weathers more readily than the quartzite, so that it rarely shows up in outcrops and is usually marked by more gradual

slopes. It carries a large percentage of dark slaty gray argillite, some dark, sandy, gray quartzitic argillite, and considerable argillaceous quartzite, as well as a few beds of the glassy quartzite. No carbonate was noted in argillaceous beds. These rocks do not stand so well in mine workings, and along fractures form much black clayey gauge.

It is generally conceded that the competent quartzites are more favourable for deposits than the argillites. The former tend to break and shatter whereas the latter tend to flow, and fractures are to a large extent cemented and rendered impervious by the gouge developed.

Projection of the argillite series brings it into the lowest mine workings where no important ore bodies have been developed.

Fracture System:

It has generally been considered that the Moyie Lake deposits are related to two main parallel fissures. The surface exposure of the main St. Eugene fracture trends directly toward the Aurora vein. However, the vein has an average dip of 65°,so that the surface exposure on a very steep slope is about 25° from the true strike. In over 4,000 feet of mine workings the strike shows a swing of only 10°. Obviously, without a very pronounced swing or marked fault, the St. Eugene and Aurora cannot be considered as part of the same fracture. Evidence strongly suggests that there is no fault (see Moyie Lake Fault, Page 20), and in the most westerly workings the St.Eugene fracture shows a 10° swing away from the Aurora.

The fracturing along the lake is in three systems which

are believed to be part of one major system. The St. Eugene system is shown in Figures 10, 11 and 12 and the Aurora in Figure 13 and the general picture in Figure 4.

There are two main fractures coming into the area near the lake from the east. The main or northern fracture is the strongest in the eastern workings but weakens toward the west and is replaced by a number not on line. The southern fracture shows exactly the reverse relationship, being strong in the west. Schofield says that there is little evidence of displacement. However, along both fractures, especially the main one, there is a marked difference in dip and strike of the bedding on either side of the fracture, which together with marked slickensliding and crushing suggests a maximum displacement of something in the order of 50'.

There are also parallel fissures, and the total number in the whole zone is considerable. Between these main and parallel fissures are S-shaped avenues or cross fractures which might be comparable to tears. They occur in the area where the main fracture is losing strength and the south fracture is gaining.

On the Aurora likewise there are a number of parallel fractures which are strong for a distance but die out in either direction, and there are cross fractures. The lower Guindon fractures are also similar.

It has been suggested that the fractures are tension fractures related to the formation of the anticline. However, the main fractures are clearly not tension fractures.

There is definite displacement, and the beds are distinctly dragged and bent in the direction in which they have been displaced. There is much gouge in places, and the walls are slickensided. The fractures are reported to continue east to the Society Girl, a distance of two miles. In general, they maintain their direction and appear to be the result of a major break developed after the formation of the anticline. As such, there is no reason why the fracturing should not continue to depth.

The avenue fissures on the other hand are probably in part tension breaks and in part due to the displacement jumping from one main break to another.

Probably the crossing of the anticlinal axis with the change in attitude of beds is responsible for the change in character of the fracturing near Moyie Lake. It is believed that under the lake the various systems are linked by parallel breaks and crossfractures, with the more northerly fractures weakening to the westward and the southerly ones strengthening. The appearence of the main break on the 1800, 1900 and 2000 levels suggests that it weakens and dies out farther to the west in successively lower levels in a position corresponding approximately to the projection of the slope of the mountain as shown in Figure 5. This feature suggests that something associated with the fracturing is the factor limiting the extension of the deposits into the mountain.

The Aurora fractures tend to die out or unite at depth. Similarly the St. Eugene fractures in the workings

near the lake tend to die out and unite, but it appears that the same strength is maintained, concentrated in one fracture, since the south fracture in the western part of the 2000 level is the strongest seen in these workings. Possibly in more argillaceous rocks fracturing may be more confined whereas in the quartzites it may tend to spread out as in the 1800, 1900 and 2000 levels. Similar conditions may exist in the Road quartzite.

On both the main and south vein the south side appears to have moved down relative to the north side. The beds on the north sides of the fractures are in a number of places distinctly curved down toward the fracture. This is in part responsible for the difference in attitude on the two sides, but other marked differences can be attributed only to considerable displacement.

Mineral Deposits:

The natural deposits, as previously noted, are so similar to the Sullivan deposit that there is no doubt that they are related. Galena, commonly a low temperature mineral, is found in association with high temperature minerals such as garnet, amphibole and pyrrhotite. The ore in the St. Eugene mine is reported to consist mainly of coarse-grained galena with minor amounts of sphalerite, pyrrhotite, magnetite, chalcopyrite and pyrite. A small amount of gangue is present and consists of pink garnet, amphibole, quartz, grunerite and some calcite. It may be that there was considerable sphalerite in places but it was overlooked. In the Aurora mine the ore consists of massive coarse-grained galena and sphalerite - in places closely intermixed and in other places separate. There is much quartz with pyrrhotite

in places, but this appears to be distinct and of different age from the ore. More quartz is reported in the upper levels of the St. Eugene mine than in the lower levels. No increase in sphalerite at depth is reported.

The northwestern part of the Sullivan ore body is said to be typical of the Moyie deposits. The Sullivan deposit is a replacement of dolomitic quartzites in the basal part of the Aldridge series whereas the Moyie deposits occur near the top of the Aldridge series along fractures. Actually it is believed that there is little difference between the two. The Sullivan deposits have a vertical range of over 4,000' whereas the total range of the St.Eugene deposit shown on Figure 5 is 2200'. Unlike the Slocan silver-lead deposits, there are no known reasons for believing that the Moyie Lake deposits should not continue to depth given favourable rock conditions.

The mineral deposits are of two types - fracture filling veins, and replacement deposits. It is believed that the more important orebodies are replacements in and along certain beds (see section page),and that they differ from the Sullivan orebodies only in the extent of replacement because the beds affected here are less pronouncedly of the character susceptible to replacement or because the solutions here moved more freely along the fractures.

One day was spent at the Sullivan mine with the idea of studying the character that makes certain beds susceptible to replacement. Rice has recently advanced a hypothesis that they are dolomitic. Many previous workers at the Sullivan failed to advance any very satisfactory hypothesis. It appeared to

me that the rock replaced was decidedly different from that not replaced. It crumbles readily, is chalky white when scratched, and strongly suggests a carbonate content. Below are hard flinty cherts which are not replaced, and above are dark glassy quartzites, also unreplaced.

In the St.Eugene and Aurora mines dark glassy quartzite and dark slaty gray argillitic quartzites do not appear to be replaced. The favourable rock seems to be the granular quartzite described under GENERAL GEOLOGY. This is similar to the rock replaced at the Sullivan. It is a fairly clean gray, and appears to have no argillaceous material. It commonly contains some calcite and dolomite. It also contains some mica and some white crystalline minerals, possibly feldspar.

This rock can be seen in the St.Eugene group especially well where the pitted quartzites (see Figures 6,7,8 and 9) are exposed, and in the mine workings especially in the roof over the drift northeast from the Fifth avenue on the 2000 level. Similar rock occurs in a cliff on the highway near the south end of Moyie Lake in the Road quartzite. Here in one section bedded material is altered and mineralized to such an extent as to have a quite different appearance. This looks like a very favourable horizon for replacement. A careful rock study of these and Sullivan materials ought to yield valuable results.

In the dark glassy quartzites, the argillaceous quartzites, the cherts of the Sullivan mine, and the argillites there are veins of the sulphides, or the sulphides with gangue,which have sharp clear cut edges and show no signs whatsoever of replacement. They cut across the bedding and appear to be due to

the filling of fractures, which may have been open. In the St. Eugene and Aurora they commonly occur at the ends of stoped areas in the main east-west veins, and as gash veins in the sections of avenues, and are in the nature of miniature avenues. They commonly pinch out very quickly. They also occur in the avenues. In the Sullivan mine they occur in the chert and glassy quartzite as stringers, mainly less than a foot wide. These stringers are very evident in the Moyie mines in comparison to replacement deposits; it may be that immediately the vein entered rock favourable for replacement it widened out to such widths that it was suitable for stoping and is not now apparent. Some of these fissure filling veins were mined, but it is not known whether they were important contributors.

Throughout the workings there are long barren stretches along fractures where there is a wide zone of broken rock or shattering which looks as though it should be mineralized. These in many places occur near or between orebodies for long distances. They are believed to be largely in the unfavourable rock.

Replacement deposits are not so easily studied because they have been partly or completely stoped and are, therefore, difficult of access. In the drift northeast from the Fifth avenue on the 2000 level the roof is largely in one bed which carries sulphides. These occur in irregular bunches and masses throughout the rock. The rock is not shattered or broken and certainly is more massive than much rock nearer fractures.

Similarly around the main stope in the Aurora there is much massive unbroken rock which carries considerable to abundant sulphides scattered through as replacements. At both

ends of this deposit there are sharply defined stringers running off in the adjacent quartzite to pinch out in short distances.

In the main, replacement does not extend far from fractures. Stoped bodies are commonly less than 10' wide. However, it seems probable that bordering many of the stopes in the favourable rock there is mineable material of slightly lower grade than that which could be mined profitably during former operations.

The mineralizing solutions apparently tended to move more along the fractures than to penetrate the wall rock. This is readily understandable in the St.Eugene quartzites where fractures are well maintained, shattering and subsidiary veins are abundant, and where little gouge is present. If, however, at some horizon there was a roof of relatively impervious material and the fractures were cemented with gouge, the solutions might have migrated farther afield and formed wider replacement bodies. Such a condition might exist below the upper argillite group in the Road quartzites. On the other hand there may be no quartzites sufficiently susceptible to replacement to permit the solutions to go far.

Controlling Factors:

Factors controlling the distribution of orebodies, already mentioned, include the presence of fractures and beds favourable for replacement. These seem to be the chief factors operative in the Aurora.

In the near-lake section of the St.Eugene mine the orebodies are in part in avenues and otherwise in the east-west

and parallel veins in the section where avenues are present. It is not true, as has been reported, that the best deposits are usually at intersections. A glance at the level plans will show that many avenues do not intersect the main vein. Many avenue deposits were found by following fractures away from the east-west veins, by driving along between the east-west veins, and by drilling. Further, stopes on avenues in the main did not extend to the main veins (see blue print of vertical projection). It, therefore, does not appear that the best deposits were developed where fractures joined, or where shattering was most intense. The explanation for better deposits in the avenue sections may be that the avenue fractures were due to tension and were more open, and also that the character of the fracture system allowed freer and larger movement of solutions.

No study of deposits to the east was made. Judging by the maps of the workings the two groups half way up the hill were confined to the north fracture. They occur where the fracture has a 10 degree bend (see blue print map of St.Eugene mine), which may have had some influence. The upper group of orebodies has complex workings which would seem to indicate a complex vein system comparable to the avenues below, and also these bodies are clustered around a dike. These factors may have exercised some controlling influence.

Former Manager R. H. Stewart reports that going down into the hill the orebodies pinch out and become poorer, and that special studies were made to ascertain the reason for

this without success. The fractures continue far beyond the limit of the orebodies. There is no reported change in character that would suggest temperature control at time of deposition. Mineral deposits continue up the Aurora slope for 600' or more in elevation so that the known orebodies are in narrow zones on either side of the valley or in a wedge-shaped section in the crest of the anticline. That these relationships have any significance is not apparent, and no satisfactory explanation can be offered for the downward limit, if there is such.

SOME OF THE EVIDENCE INDICATING SELECTIVE REPLACEMENT OF BEDS:

1. The pattern of stoped areas shown on Figure 5 and the blue print of the vertical projection of the workings is decidedly tabular. Many stopes have long, flat tops or bottoms which parallel the intersections of the bedding planes with the fissures.

2. The pattern in this regard is remarkably similar in the main and south veins. (The south vein stopes extend lower than the north vein stopes whereas the dip is northward. Downward displacement of the south side may explain this in part).

3. Similarly the avenues have produced ore at the same stratigraphic horizon as the main and south veins.

4. In the Aurora mine the stopes on the Sullivan and main fractures are in the same stratigraphic horizons.

5. For long stretches on levels good vein zones are barren. As the bedding planes along the levels are nearly horizontal the levels persist in about the same beds. In places stopes

with horizontal tops or bottoms begin at a short distance above or below the barren stretches in the levels.

6. In the northeast drift off the Fifth avenue the walls for 60' carry no noticeable sulphides but the roof, which for this distance is the base or near the base of one bed, is heavily replaced by sulphides.

7. Many stopes of good widths end abruptly against a roof which is a bedding plane and which shows no evidence of a continuation of the orebody stoped, or at best only small stringers of fissure filling material.

8. There are extensive areas of shattering and other good structural conditions which show no mineralization.

SEARCH FOR ORE IN THE OLD WORKINGS:

No serious attempt was made to search out the possibilities of finding ore in the old workings, and some work will have to be done there before this can be attempted. However, a few observations were made that may be of value.

1. The bed in the roof of the northeast drift from the Fifth avenue on the 2000 level contains a lot of sulphides and should be examined. It is gently undulating and might be probed by flat lying holes in the bed or holes driven up into it from the level across most of the area between the two veins.

2. Because of the northward dip south of Parallel B. vein this bed would lie above the drift level. It has, therefore, not been tested south of the drift where it would intersect the main south vein as hole 115 was probably horizontal and too low, and holes 34 and 37 from the 1900 level were probably too high.

3. Sulphides occur in places along the Second avenue, suggesting that what may be the same favourable bed may carry considerable ore of slightly lower grade than that profitably mined during former operations. Careful study throughout the 2000 level should be made to ascertain whether this favourable bed has been tested at all points where intersected by fractures.

These are not all the apparent possibilities of making ore in the old workings. Mr. S.S.Saxton, the Manager of the mine, is accumulating information on this subject.

It should be noted that the former management, though stating that geology was not used in the search for ore and should be a valuable aid, is of the opinion that little ore is likely to be found in the old workings.

The Rossland mines, abandoned at about the same time as the St.Eugene, are reported to have yielded over $5,000,000. worth of ore to leasers.

MOYIE LAKE FAULT:

R.H.Stewart, former Manager of the St.Eugene, and others have suggested the possibility of a fault along Moyie Lake. It is not thought that such a fault exists for the following reasons:

1. No evidence of it is shown on Figure 2. The contacts of sills and formations are not offset.

2. If the Aurora and Guindon veins were offset from the St.Eugene by faulting the offset is of the west side to the south. On the other hand, the swing of contacts between the groups of sediments on the east side of the valley south of †

St. Eugene could more reasonably be more sharply to the westward, while on the other side of the lake it could more reasonably be less sharply toward the east. This would suggest an offset in the opposite direction to that suggested by the veins.

3. The angle between the bedding and the St.Eugene vein is about 110°. If the steeper dips of bedding on the west side were due to a rotational fault, the veins, if a continuation of the St. Eugene veins, should dip less steeply to the south, whereas they dip more steeply and are only 60° from the bedding.

4. No parallel faulting along the valley walls was noted.

(Signed) FORREST A. KERR

November, 1937.

R E P O R T

ON THE

MINING PROPERTIES

ST. EUGENE EXTENSION MINES, LIMITED
N. P. L.

M O Y I E

EAST KOOTENAY

BRITISH COLUMBIA

C O N T E N T S

(Maps in separate folder)

R E P O R T

ON THE MINING PROPERTIES

ST. EUGENE EXTENSION MINES, LIMITED, N.P.L.

MOYIE, EAST KOOTENAY, BRITISH COLUMBIA:

SUMMARY AND CONCLUSIONS:

The vein system has produced over a million tons of ore of commercial grade in the St.Eugene Mine, and additional ore on the west side of the Lake in the Aurora Mine, where considerable development has been done. It is, therefore, reasonable to assume that the continuation of the St. Eugene vein system, which undoubtedly extends through the Cambrian property to the west side of the lake, will contain shoots of commercial ore, the extent of which can only be demonstrated by development and diamond drilling, but perhaps rivalling those encountered in the St. Eugene Mine. I consider that the ground underlying Moyie Lake can be safely developed and mined by competent mining men. The geological conditions, transportation, power concentrating and smelting facilities all are exceptionally favourable, and I have no hesitation in recommending the expenditure of the necessary amount to develop the St.Eugene Extension area, particularly that part of the area in the Cambrian property, underlying Moyie Lake and the lower horizon of the Aurora Mine.

An equitable arrangement has been made for the use of the St. Eugene shaft, supply of power for preliminary work, etc., so that taking everything into consideration the project has more favourable factors than any silver-lead-zinc prospect I know of in Canada today.

NAME OF PROPERTY:

St. Eugene Extension Mines Limited, N.P.L. Moyie, B.C.

LOCATION OF PROPERTY:

Moyie, East Kootenay, British Columbia, Canada. On the Crow's Nest Branch of the Canadian Pacific Railway. Short connection also the Great Northern Railway via Elko, B. C.

AREA:

A well rounded group of claims covering over 6000' along the strike of the veins profitably worked in the St. Eugene mine.

TRANSPORTATION AND POWER:

The Canadian Pacific Railway and transmission line to the St.Eugene concentrator pass within one hundred yards of the property. A supply of power for all preliminary work assured at very reasonable rate.

ADJOINING PROPERTY:

The St.Eugene Mine, which produced over $18,000,000.00 in silver, lead and zinc at pre-war prices of metals and under heavy zinc penalties at the smelter. The production from the St.Eugene Mine at present prices of metals and recovery under flotation process of concentration, would amount to approximately Fifteen Million Dollars ($15,000,000.00). THE PROPERTY CONTAINS THE CONTINUATION OF THE ST. EUGENE VEINS.

PRODUCTION AND CHARACTER OF ORE:

The St.Eugene Mine produced over a million tons of ore averaging about 8 oz. silver, 15% lead and 4% zinc.

The Aurora Mine, operating on the south vein, shipped

over 3300 tons of ore to the smelter averaging 3.25 oz. silver, 7.74% lead and 18.5% zinc. The Aurora ore should have been concentrated before shipment to the smelter.

The Cambrian property has not been developed to date. It underlies Moyie Lake and adjoins the Lake Shore claim of the St. Eugene Mine, and undoubtedly contains the continuation of the St. Eugene veins.

HISTORY:

An unsuccessful attempt to develop the Cambrian property, which underlies Moyie Lake, was made years ago by sinking a shaft in the bed of Moyie Lake. The venture was not a success, due to improper financing and to the methods adopted to sink the shaft to bed rock. The present arrangement, whereby several properties are consolidated under one efficient management, eliminates the necessity of sinking a shaft in the bed of the lake, and affords a logical method of development from the railroad side of the lake.

The Aurora property was regarded as a refractory ore until the development of the flotation process. Such ore could not be successfully concentrated, and was highly penalized at the smelters, making it impossible to mine the ore at a profit. Improvements in concentrating practice have entirely eliminated that difficulty, and the accompanying zinc penalties at the smelter have been removed, thereby greatly enhancing the possibilities for profitable operation.

LATER DEVELOPMENT:

The properties were carefully surveyed and mapped, and

it was decided to concentrate preliminary development on the Aurora Mine, as that property was held under option to purchase. The net result of preliminary development has been to demonstrate conclusively that the Aurora Mine was not "bottomed" at the upper level, as was formerly believed, but that the ore was cut off by a horizontal slip or fault. The vein was soon picked up in a winze and followed to a depth of approximately 52'0". The vein varying in width from twelve inches to over five feet, and assaying up to 51.3% lead and 17.1 oz. silver, averaging about 14% lead, 5.5 oz. silver and 18.5% zinc per ton.

A lower tunnel, driven by previous operators of the Aurora Mine was found to habe been started and driven in the hanging wall of the south vein. After carefully surveying and mapping the level was continued to pick up the vein at this elevation. The vein was then followed with a drift and a raise started on the vein to connect with the winze mentioned above. Ore of similar character to that mentioned in the winze was encountered in the raise, which has only about fifteen feet to be driven to connect with the winze.

METALLURGY:

No metallurgical problems or difficulties to overcome. Similar ore is being successfully concentrated by selective flotation with splendid recovery and clean separation of lead and zinc concentrates. The zinc penalty on lead ores has been entirely removed at the Trail Smelter.

GEOLOGY:

Pre-cambrian formation. Aldridge quartzite. Same formation as the famous Sullivan Mine, one of the largest lead, zinc mines in the world, also situated in the East Kootenay District. Same formation as the North Star, Stemwinder and St. Eugene Mines. Similar geological conditions to the Coeur d'Alene District in Idaho. The veins are true fissure veins and converge both along the strike and dip as they approach the Company's property. Area contains the continuation of the St. Eugene Mine vein system. S.Schofield, Dominion Geologist, mentions the AXIS OF AN ANTICLINE passing under Moyie Lake and cut by the St. Eugene veins. This indicates a likely place for the formation of ore bodies on account of the anticline and also on account of probable cross fracturing at that point. The beds of quartzite which were most productive in the St.Eugene Mine are believed to lie at greater depth on the West side of the Lake and have not yet been developed.

REPORTS:

Favourable reports by four well-known mining engineers and a Dominion Geologist.

MINE EQUIPMENT AND FACILITIES:

The mine is equipped with compressor, mine cars, rails, air lines, etc., for preliminary development purposes. Camp buildings are available for the accommodation of the necessary employees. No expenditures are required for roads or transportation. The property is close to the railroad and power transmission line. Electrical power is available at

very reasonable rates.

SUGGESTED DEVELOPMENT PROGRAM:

Unwater the St. Eugene shaft and drive one or more levels into Cambrian ground, these to serve as a basis for further development and diamond drilling to thoroughly prospect the area.

COMPARISON WITH COEUR d'ALENE DISTRICT, IDAHO:

The geological conditions, type of veins, general character of the ore, silver ratio, etc., are similar to the Coeur d'Alene District in Idaho, U.S.A., which district is situated only a short distance south of the International Boundary line.

Many of the Coeur d'Alene Mines have been in profitable production for over thirty years. The veins and ore bodies extend to great depths. Several of the Mines have paid over $20,000,000.00 in dividends, and the indications are that they will continue in profitable production for many years to come.

There is no secondary enrichment in the St.Eugene ore deposits, and they occur under conditions similar to the Coeur d'Alene Mines. The quartzite formation extends to great depth, and the prospects of developing profitable shoots of ore are very good at favourable points -

a) Where cross fracturing occurs, or

b) Where the fissure veins intercept favourable beds of quartzite.

c) Where the veins converge along the strike and dip on the Cambrian property, or

d) Where the veins intercept the anticline under Moyie Lake.

CONCLUSION AND RECOMMENDATION:

Therefore, after giving the matter careful consideration, over a long period of time, I am fully convinced that the project has all the earmarks of developing into a successful and profitable Mine, and I have no hesitation in recommending the expenditure of the necessary money to develop the property.

(Signed) Ridgeway R. Wilson, B.Sc., M.E.

Registered Professional Mining Engineer, Province of British Columbia.

Member, American Institute Mining and Metallurgical Engineers.

Member, Canadian Institute of Mining and Metallurgy.

DESCRIPTION OF MINES AND PROSPECTS

The Moyie Area -

by

Dr. S. G. Schofield, Geological Survey of Canada.

The Moyie area embrances the area around Lower Moyie Lake, and includes the Society Girl, St. Eugene, the Cambrian and Mabelle Claims, the Aurora, and the Guindon Group of Claims.

GEOLOGY:

The Moyie area is underlain by the Aldridge and Creston formations of the Purcell series. These formations are folded into a northerly dipping anticline, the axis of which roughly coincides with the depression occupied by the Moyie Lakes and River. The Aldridge formation occupies the axial portion of the anticlines and consists of dark grey argillaceous quartzites in beds up to 1 foot in thickness, and dark grey siliceous argillites generally not exceeding 2 inches in thickness. The weathering colour of these rocks is a dark, rusty brown, which is the most valuable field characteristic in its determination. On the eastern side of the lake, in the vicinity of Moyie, the rocks strike east and west with a dip of 30 degrees to the north, and are close to the axis of the anticline, while in proceeding eastward up the hill towards the Society Girl the formation gradually changes its strikes to a northwest-southeast strike, with a dip of 25 degrees to the northeast, as would be expected in going from the axis of the anticline to its eastern limb. On the hill to the west

of the Lake, where the Aurora and Guindon group of claims are located, the strike is northeast-southwest with a dip of 20°, to the northwest. The axial portion of the anticline is occupied by the Creston argillaceous quartzites, purer quartzites, and dolomites which are well exposed on each side of the Upper Moyie Lake.

FISSURE SYSTEM:

All the ore deposits in the Moyie area are connected with two main parallel fissures striking a little north of west and dipping on an average 70° to the south. They cross the axis of the anticline composed of the Aldridge formation. These two fissures occur on both the east and west side of the Lake, and it is probable that they occur in the rock formation under the lake. The walls abounding the fissures show very little evidence of relative displacement, the greatest movement observed being 18 inches; however, in such a homogeneous series of quartzites the detection of such a movement might be impossible.

AURORA GROUP OF CLAIMS:

The Aurora Group consists of five crown-granted claims, the Aurora, Horse Shoe, Durang, Etna and Portland, situated on the west side of Lower Moyie Lake opposite Moyie, B. C. The vein occurs on the east and west system of fissuring described in the general description of the district, and possibly on the southern of the two main fissures which here has a general strike east and west, but varies as much as 15 degrees from this direction. The dip of the vein is 60° to the south. The vein

cuts across the Aldridge formation, the oldest subdivision of the Purcell series, which here strikes northeast with a dip of 50 degrees to the northwest.

The formation is made up of thin-bedded argillaceous quartzites (locally called slates) and massive purer quartzites which here form the western limb of the northerly plunging anticline described above. The vein has a maximum observed width of 6 feet and consists of zinc-blende and galena with very little gangue. Occasionally fragments of the wall rocks are enclosed by the ore. In the report on the Zinc Resources of British Columbia, the following assay of the ore is quoted; gold 0.02 ounces, silver 7.3 ounces, lead 31.5 per cent, zinc 33%. The ore represented in the Aurora is also considered by the same commission to be the simplest to treat of any of the ores examined in their series of experiments.

GUINDON GROUP CLAIMS:

This group, consisting of the Guindon, Fereole, the Alice and the St. Joseph fractions, is located in the territory adjoining the Aurora Group to the north. The vein on which these claims are located is about 700' north of the Aurora vein, and has an east and west strike with a dip of 60° to the south. The formation which the vein traverses is the Aldridge formation, which here strikes north-east and dips 20° to the northwest. The vein is from 4 to 5' wide, and in one tunnel the ore was 18" in width. It consisted of galena, zinc-blende and some pyrite.

CAMBRIAN AND MABELLE CLAIMS:

The Cambrian and Mabelle crown-granted claims embrace

the territory between the St. Eugene Consolidated and the Aurora and thus lie for the most part under the waters of Lower Moyie Lake. The extensive zone of fissuring, described in the general statement, and which occurs on both sides of the lake, is to be expected to occur in the intervening territory. As the veins are mineralized in the St. Eugene Consolidated and in the Aurora it is logical to expect that the Cambrian and Mabelle claims will also be productive. The sounding of the Lake on the Cambrian and Mabelle Claims revealed the maximum depth of water to be 140 feet, and in addition 90 feet of blue clay and hard pan cover the bottom of the lake.

I can recommend for exploration any property in this area.

(Signed) STEWART G. SCHOFIELD

May 10, 1928

JOHN M. TURNBULL
Mining Engineer
736 Granville Street,
Vancouver, B. C.

VANCOUVER, B. C.
May 9th, 1928

Ridgeway R. Wilson, Esq.,
2619 Cavendish Avenue,
VICTORIA, B. C.

Dear Sir:

I examined the "AURORA", "GUINDON" and "CAMBRIAN" mining properties on April 21st - 23rd - 1928, at your request.

My general conclusion, based on the above examination, and on familiarity with the St. Eugene Mine, for many years, is that the possibility of finding ore in profitable quantity and value, in the above properties, is very good and thoroughly warrants you in carrying out the development work necessary to determine their possibilities.

Particularly I approve of the plan of preliminary development, which consists in unwatering the St. Eugene mine shaft and lower levels, and in continuing one or two of these levels into the adjoining Cambrian ground, where they may be made the base for subsequent development and diamond drilling. The plan of carrying on only minor developments on the AURORA and GUINDON for a time, until information is gained from the CAMBRIAN work, is likely also to prove most satisfactory in regard to the three properties, in the long run.

I consider that your best prospect of finding important orebodies lies in the extension of the St.Eugene main

vein, and in finding orebodies similar to those which occurred in that vein. The prospect of finding cross fracture or avenue orebodies is more dountful.

The St. Eugene main vein produced something like half of the total tonnage from the mine, or about 500,000 tons, which, on present metal prices, and including Zinc values, would amount to a gross value of about $10,000,000. These main vein figures are the ones which can fairly be used as a comparison on which to base your prospects in the above properties.

Making allowances for the differences in conditions and considering that the South vein also proved productive on Aurora ground, I consider that the prospects are of sufficient magnitude and importance to warrant you in incurring reasonably large expenditures in preliminary developments.

Yours very truly,

(Signed) J. M. TURNBULL

R E P O R T

ST. EUGENE EXTENSION MINES LIMITED (N.P.L.)

by

John Drybrough, Consulting Mining Engineer,
Winnipeg, Manitoba

SUMMARY:

There seems to be no reason why orebodies similar to those on the St. Eugene should not be found in the extensions of the veins beneath the lake as far as the axis of the anticline at least. The exploration on the St.Eugene was only carried a short distance beyond the last orebody and is by no means conclusive. Geological conditions at the axis of the anticline in the lake should be favourable for the deposition of ore.

West of the lake the veins exposed are smaller and may not have the extensions of the St. Eugene veins. They have some possibilities at depth but the best chances of finding ore lie in the area beneath the lake.

There is no reason to expect an unfavourable change of formation before considerable depth. Elsewhere in this formation in the Coeur d'Alene region, the ore has been found to persist through a great vertical range. The Consolidated properties amply protect the veins on strike and dip. The ore presents no metallurgical difficulty.

There are many favourable factors affecting operation - The considerable saving by the right to use the St. Eugene shaft sunk 650 feet below the lake level, cheap electric power and railway transportation on the property, a customs concen-

trator adjacent, a minimum expenditure for plant and buildings and ample timber for mining purposes available on the property.

I recommend this venture as having the reasonable possibility of finding sufficient ore to make a small mine, with the further chance of duplicating the record of the St. Eugene, or even better.

(Signed) JOHN DRYBROUGH

March 11, 1929

NOTE:

Since Mr. Drybrough's examination of the property was made, additional development work on the Aurora property on the west side of the lake has proven conclusively that the vein continues to the lower horizon, ore having been encountered in a winze, raise and on the lower level, thereby greatly increasing the chance for successful development (see maps and sections accompany this report).

Mr. John Drybrough, Consulting Mining Engineer, was formerly with Mond Nickel Company near Sudbury, Ontario, and is now Mining Engineer for Jas. Richardson and Sons, Winnipeg, Man.

SHIPMENTS TO TRAIL SMELTER FROM AURORA MINE

NOW PART OF ST. EUGENE EXTENSION MINES LIMITED PROPERTIES, MOYIE, B.C.

Aldridge Siding - Aurora Milling Ore.

Lot #	Tons	Gold Assay	Silver Assay	Silver Ounces	Lead Assay	Lead Pounds	Zinc Assay	Zinc Pounds	Amount Paid Mine	Net Value Per Ton
1-C	36	.01	2.5	89	5.45	3,893	19.7	14,072	103.51	2.88
2-C	251	Tr.	3.0	752	6.7	33,337	18.4	92,241	2,037.39	8.12
3-C	315	"	3.1	975	6.8	42,478	15.8	99,431	2,219.81	7.05
4-C	119	"	2.5	298	6.1	14,432	15.9	45,086	1,098.40	9.23
5-C	115	"	2.7	310	5.9	13,445	18.4	42,289	1,139.89	
6	171	"	2.5	429	6.2	21,095	19.2	66,861	1,826.78	
7	121	"	3.0	363	7.1	17,042	12.0	29,007)		
8	131	"	4.4	575	11.6	30,336	19.6	51,257)	2,589.08	
	538	"	3.1	1,677	7.6	819.18	17.5	188,414	5,555.75	10.33
9	69	"	3.5	241	10.2	140.33	21.7	29,854		
10	66	"	3.2	211	8.1	9.036	15.0	19,787		
	135	"	3.3	452	8.5	23,069	18.3	49,641	1,321.34	9.79
11-C	69	"	3.1	215	6.7	9,225	15.9	22,057	588.71	8.53
12-C	79	"	3.0	236	7.0	10,799	20.0	31,476	665.86	8.43
13-C	65	"	2.4	157	5.6	7,238	12.6	16,432	344.12	5.29
14-C	85	" Oxs.	3.5	299	8.1	13,755	23.3	39,812	816.84	8.61
15	68	.01.1	3.7	251	8.1	10,925	21.5	29,177	818.42	12.03
16	55	.01.1	2.8	155	6.0	6,570	23.7	26,168	661.44	12.04
17	65	Tr.	3.9	254	9.6	12,446	21.5	28,019		
18	67	"	3.3	220	8.6	11,391	24.0	31,975		
	132	"	3.6	474	9.0	23,837	22.7	59,994	1,680.73	12.73
19	59	"	3.0	177	7.3	8,562	12.4	14,644		
20	64	"	3.5	226	9.0	11,545	18.2	23,477		
	123	"	3.3	403	8.2	20,107	15.5	38,121	986.87	8.02
21-C	62	"	4.5	281	8.1	10.041	17.1	21,329	549.47	8.86
22	61	"	4.1	250	9.1	11,055	20.1	24,554		
23	50	"	3.1	154	7.8	7,676	18.8	18,621		
	111	"	3.6	404	8.4	18,731	18.4	43,175	1,109.32	9.99
24	70	"	3.1	218	7.5	10,493	20.8	29,296	657.26	9.39
	3352	Tr.	3.25		7.74%		18.5%			

Copies by MEB
Trail, B. C. Jan. 2nd, 1929

C O P Y

R E P O R T

ST. EUGENE MINING CORPORATION LIMITED, N. P. L.

by

J. G. GWILLAM

ST. EUGENE MINING CORPORATION LIMITED,N.P.L.

(From a copy of Report by "J.G.Gwillam"

GEOLOGY:

The country rocks are bedded Quartzites and Argillites, with some dikes at the eastern end of the property. These bedded rocks are remarkably undisturbed and dip gently to the north and north-east. They do not appear to be much affected by any observed igneous intrusions.

The rock beds vary in texture and thickness. The lower levels up to 2000' level are in somewhat thin bedded quartzites and argillites.

From 2000' level upwards to 600' level the beds are coarser in texture and thickness but there are some more argillaceous beds inter-stratified with them, notably at 1100' and above 1000' levels.

From 600' level to the upper workings the beds are chiefly fine with a belt of coarser rocks at end below the 300' level. Any given tunnel or level runs along one set of beds for some distance but usually penetrates overlying strata as it proceeds eastwards or into the mountains.

There are also some breaks and undulations in the strata which cause more rapid changes in the rock along any level. The country rock considered as a chemical or precipitation factor does not show evidence. The coarser quartzites carry more lime than the argillites and may undergo chemical replacements more readily. Otherwise the outside country rock of these mines may be considered as one simple

factor a regular block of slightly inclined strata which strata vary in texture and quality as one passes downwards or upwards through the mine.

This normal country rock has many joint planes. These have been, to a large extent, followed by any fissuring that has taken place. Small fissures filled with bull quartz are somewhat common; they usually run SE and dip NW, another set of faults or gouge planes runs N and S; neither of these appears to be mineralized or to disarrange the dip of the wall rock. But within these regular general conditions there is a block of country rock <u>specially</u> fissured.

<u>The Fissure System of the Ore Bearing District.</u>

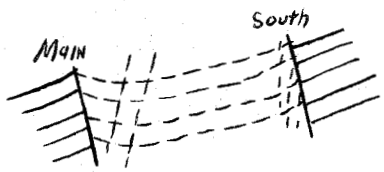
The boundaries and outline of this system are defined by the main and south veins on gouge planes. These converge towards Moyie Lake and also in depth, thus a wedge shaped area is formed. This wedge shaped area, unlike the usual country rock, has suffered many strains of bending and crushing within itself. This special and local disturbance of the beds has resulted in subsidiary folds, fractures, shearing and crushing; all of which are most intense in the thinner part of the wedge, i.e. the avenue district just east of the shaft. This subsidiary dislocation of the rocks has caused 4 principal disturbances within the confining planes, i.e. the north and south veins.

(a) A series of fractures with or without movement afterwards. These are diagonally across from the main to the south vein, they usually dip to the south and like all the other fissures probably follow a jointing plane of the strata, some-

times jumping courses and so step down at a low angle.

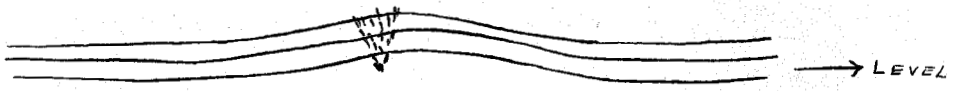
(b) Breaks forming walls, sometimes gouge planes, more or less to parallel to the main and south veins, and at points between them. These are also probably along joint planes and are the lines of relief under "C".

(c) A brushing up of the beds on the main and south vein walls. This causes a rapid change in the dip of the rocks, which must result in fracturing them parallel to the confining walls, unless the rocks are soft enough to shear. Thus a series of parallel planes will be formed with more or less crushing of the rocks between them, forming a porous rock with nascent or fresh fractures suitable for mineral replacement.



(d) Cases where the folding movement has been concentrated on an irregular area, causing an irregular fracturing and lower mineralization. (There are folds across the system as well as parallel to it). Cases where the rocks have been comminuted or sheared under the pressure and so form belts and areas luted with fine pulverized material and unsuitable for mineralization. These latter are most likely in the softer rocks. The same condition exists in the brecciated gougy

planes.



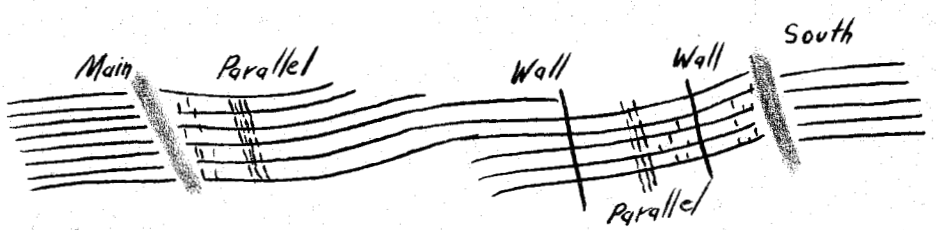
EXAMPLES:

Under "A", avenues usually break across from the main to south but do not pass into the outer walls of these. They may sometimes tail off as "tadpoles" of (the) quartz which pass for a short distance into foot of main and hanging of south. See 1836 and 4th avenue below it. Such may be the results of the cross undulations of "d".

Under "B" parallels and walls, with ore or disturbed rock between (See 1859 stope south, 1962 main and 1050. See 2064 stope south).

Under "C" these are common in most places within the vicinity of the orebody. See footwall 1900 south from 2nd avenue to 4th avenue above stope 2064, also main from 2nd to 4th avenues.

Under "D" various indeterminate areas of low grade ore, such as from 1st to 2nd avenue 1900; 5th avenue 1900; 2179 of 2100; 5th avenue 2000'.



This cross section is a little idealized because the subsidiary (red) fractures jump from one place to another. However, it is just as pronounced in various places especially on and between 2000-1900 and 1800 foot levels.

Thus we have up to this point a steady regional country rock such as may be found on any of the surrounding hills, dipping gently north and eastwards.

Within this normal condition there is a wedge shaped mass of country rock which has suffered local and special disturbances, which has been most intense about the point where the wedge gets thinner, and is more easily fractured across; and along the main vein where the rocks appear to have been bent upwards on the hanging wall. Combined with these there has been a rolling or undulation across, normal to the course of the veins which may have induced the cross fractures or avenues and the side stringers of quartz.

THE ORE BODIES:

These are found in three more or less distinct disconnected areas. The St. Eugene chutes, the Moyie chutes, and the Lake Shore shoots, parallels and avenues. Generally these ore bodies are associated with some visible compound fracturing of folding of the hanging wall side, but this condition is sometimes obscured by the garnetization and silicifying of the disturbed rocks. This is more true of the St. Eugene and the Moyie areas. The lake shore being the type already taken up, as consisting of avenue, parallels and cracked or shattered zones.

Some of the stopes become poor when the troubled area which accompanies them enters a more plastic or more sheared rock. This may be seen on 650 stope and the east end of 855 stope. Sometimes the double plane, compound fracture ceases, and it is continued as a single plane of brecciated rock between regular dipping strata, which appears to be unfavourable.

Sometimes the so-called parallels converge to a single plane of brecciated or sheared rock and the ore dies out or conversely the parallels diverge sufficiently to leave a solid regular mass of rock between them, the ore might follow one or both walls or soon cease. Single fracture planes crossing regular beds, accompanied by a band of badly crushed or sheared rock and gouge seem unfavourable as shown by the eastern extensions of 1300, 1800, 1050, 1270 and other levels.

But single fractures in avenue directions seem to carry ore. These however are rarely clean cut planes but irregular, probably often stepping of offsetting along bedding planes, and having sometimes varying dips of the beds on opposite sides; thus the rocks may dip more steeply one side than the other showing a considerable bending strain before the relief took place along the avenue jointing. Second and fourth avenues show a good deal of gouge and companion walls, as do some of the main parallels; this may have been produced since the formation of the ore bodies without extensive movement. The low gougy bedding planes which sometimes cut off the ore may not indicate in some cases, fault movements, but planes which have diverted solutions in other directions.

So far the following data has been observed:

(1) A remarkably regular country rock outside the wedge between main and south veins.

(2) A subsidiary dislocation of the rocks, resulting in steeper dips, reversed dips, parallel planes, avenue fractures, broken zones and areas, sheared zones and areas.

(3) An association of ore bodies with this subsidiary dislocation.

(4) An absence of ore bodies where the vein matter is a comminuted or sheared fracture passing through otherwise undisturbed rocks.

EXCEPTIONS:

The ground above 800' is more easily broken, there are many gougy planes, striking south-easterly and southerly. There has been plenty of fracture planes, and a diffusion of them which makes the line of the main veins a little uncertain.

The ore bodies above the 200' and 100' are on fractures running avenue wise and are apparently north of the main vein. It is possible the main vein or what is left of it beyond 600' passes to the north of these occurrences, or these occurrences may be the feathering out of the main vein in softer rocks.

INFERENCES:

Accepting the observations cited, it will be reasonable to suppose that the coarser, more rigid quartzite beds between 600 and 2100 will fracture and break under folds and thrusts. This folding being a diversion of dip of a few degrees up to 45 degrees in some cases.

This fracturing will leave such a rock in a porous condition and with fresh ungouged surfaces, a condition favourable to mineralization. On the other hand softer more thinly bedded argillaceous rocks will be more likely to squeeze and shear, cementing or luting up their spaces as formed, also presenting a less favourable situation chemically, than the quartzites which hold some lime.

Placing, however, most dependence upon physical than chemical peculiarities, one would expect to meet ore bodies where the coarser rocks show signs of considerable deflection from their regular course (a gentle dip north of northeast) for such deflections in such rocks must cause open fractures unless the pressure is too great to allow them. Stope 1050 is, however, apparently in finer rocks but here there has been considerable shaking up and folding, the strata dipping from both sides towards the ore, while the pressure may not have been great enough to seal up the fractures. The same applies to the ore bodies above the 200' level.

OUTLYING DEVELOPMENTS:

(1) The eastern extension beyond and around the 100' level appears to have passed into many fractures, some of which trending east and southeast, bear ore then fade away or conflict with cross fractures, ultimately ceasing against a mass of fine grained massive rock which lies a few hundred feet east of the uppermost workings.

(2) The inner workings of 1500 and 1800 foot levels up to the dike show a long stretch of undisturbed ground save the single gouge plane of the main vein, but on nearing the

dike the ground becomes more broken, looser and sometimes a little folded. Certainly the hanging wall might be broken into where it is smooth and fails to show bedding, otherwise the prospects are not encouraging, but more so within a few hundred feet of the dike, especially where rocks are strong and somewhat folded, as marked on blueprints.

(3) The lower levels 2100, 2200, 2400:

These levels are chiefly in slates or argellaceous beds - the beds which crop up a short distance south of the mill on the railway. These are often pyritous, showing a threadlike banding of pyrites parallel to the strata, such rock occurs in the upper levels in unmineralized portions. These beds have been sheared and folded and fractured in parallels to some extent on 2100 less so on 2200 and still less on 2400, which as far as developed shows a rather regular 20°-25° dipping slate with a few strong joint planes and possibly the downward continuation of the main vein as a tight lightly gouged fracture. A dark unpyritized limy rock underlies 2400 conformably, its analysis is very similar to that of the interbedded lime dike which occurs on the walls of 350 stope, but has no apparent significance. The strong quartzites of 2000 foot level probably extend for some distance downwards towards 2100 and if sufficiently fractured may offer something. The ore on 2200 occurs at a change of dip in the rocks.

PROMISING GROUND:

If the foregoing observations are correct, work should be guided considerably by them, but on general principals all the ground between any known ore bodies should be worth developing.

There is a large area between the 800 and 400 ft. levels which shows no particular merit judged by the aforesaid observations, yet it is not proven. If anything the northern portion adjacent to these levels offers the most.

Between the 1000 and 800 foot levels there is much possible ore-bearing ground.

From the 1100 downwards to the 2100 in the western portions there appears to be conditions which may produce orebodies at any point. The large area between 1100 and 1700 having strong rocks and considerable folding. Present appearances are against the eastern extensions of the main and south levels wherever the rocks get very regular and slatey or fine-grained.

Considering that the orebodies may depend upon fracturing within the main and south veins the hanging wall of the main and the foot of the south, should be considerably prospected, if necessary, to show the dip of the rocks. Also if there is any merit in the more rigid beds of quartzite, it will be noted that these may be reached by upraises, while the levels above and below may continue for a long time along the softer beds.

I have kept my observations and my inferences apart as much as possible, so that the former may be used without prejudice. Blueprints, of all the levels have been annotated and left in the St.Eugene office with Mr.Blaylock. These will show the most noticeable changes of dip in the rocks,but stope observations could not be placed on them very well.

"J. G. Gwillam"
(Copied by P. A. Chubb)