

Property File

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REPORT OF EXAMINATION  
OF THE  
MONARCH AND KICKING HORSE MINES  
AT  
FIELD, B. C.

To MR. F. H. Weekes, Manager  
Porcupine Goldfields Development & Finance Co. Ltd.

By Charles C. Starr.  
December 1, 1926.

## INTRODUCTION:

This examination was made at the same time as that of R. D. Hearn, and was principally concerned with the economic geology of the ore occurrence, and the prospect of favorable future development. Sampling of the mine was done under Mr. Hearn's supervision and his report and maps should be consulted in connection with this. On account of snow, and the exceedingly precipitous topography of the area in which the mines are situated, little surface work was done, but considerable data was obtained from Memoir No. 55 of the Canadian Geological Survey.

## LOCATION:

The property is situated three and a half miles north east of the town of Field, on the western slope of the Rocky Mountains and on both sides of the Kicking Horse river.

It is in the Yoho Park, reserved by the Dominion Government, and in the Golden Mining Division.

## PROPERTY:

The property consists of the Monarch and St. Etienne Fr., Crown Granted Mining Claims (about 70 acres); the Kicking Horse and other claims, held by location, besides other mineral and surface rights under lease or applied for from the Government. The property is owned by S. E. Harkins and associates, and is under lease and bond to the Pacific Mines Ltd.

## TRANSPORTATION:

The main line of the Canadian Pacific Railway crosses the center of the property, about 200 feet above the valley floor. A good road connects the old concentrator, the camp, and the

town of Field, etc.

**POWER:**

In the former operation of the property, water from a small glacial stream was used for power, but fails entirely during the winter months.

During the later development, power for a compressor was developed by coal which, it is said, costs \$7.00 per ton at the railway.

There is no question that electric power could be developed for year around work in any amount required, within a few miles of the mine, but permission for such development must be obtained from the Park Commission.

**WATER:**

Water may be obtained in the river bottom from shallow wells for domestic use, or, during the summer months, from various glacier fed streams above the mine workings.

For winter use at the mines, water would have to be pumped from the river, a vertical height of 1000 feet, as the mines are dry.

**TIMBER:**

Timber suitable for mine use is not plentiful near the property, and it is probable that the Park Commission would not permit its being cut.

*at* → **PRICE & TERMS:** - are subject to negotiation.

**HISTORY:**

The Monarch Mine was first located in 1885, and is one of the earliest mines worked in the Province. It has changed hands and names several times. In 1912 a 70 ton concentrator was built and operated for a short time with fair

recoveries of lead.

A very considerable tonnage of crude lead ore has been shipped, and a much larger tonnage concentrated, but there seems to be no authentic records of the gross production.

The Kicking Horse mine is a relocation of the Black Prince mine; it has also changed hands several times and has made no production.

**EQUIPMENT:**

Monarch Mine: Compressed air is piped to the mine through 3 inch pipe; A 1 inch water line brings water to the mine by gravity but the supply fails in the winter.

The mine workings are equipped with track and cars. Two poorly equipped blacksmith shops are located, one at the outer end of the "old stope," and the other at the outer end of the "new Stope".

A new partially dismantled aerial tram lead from the "old Stope" to the concentrator.

A cable with a hoist-operated bucket reaches from the portal of the main entrance tunnel to the concentrator, and is used for bringing up supplies. Ingersoll-Rand Leyner drills were used.

Kicking Horse Mine:-

The mine workings are equipped with track and cars. Air and water lines are laid to the mine but are not now connected up. A hoist operated, single bucket, aerial tram leads from the compressor plant to the No. 2 tunnel and is used for raising supplies.

**CONCENTRATOR:**

A 60 or 70 ton concentrator using jigs and tables is

situated near the Monarch mine and immediately above the railway track. It is of an obsolete type and of little value.

COMPRESSOR PLANT:

The compressor plant is situated on the north side of the river at the Kicking Horse Camp. It consists of a 320 foot Ingersoll Rand single stage compressor with steam cylinder on the same piston rod; it appears to be in good condition. Steam is furnished by two locomotive type boilers totaling 70 H.P.

MONARCH CAMP:

The Monarch camp is situated below the railway and near the concentrator. It consists of four or five log buildings.

THE KICKING HORSE CAMP:

This camp consists of a half dozen buildings, part frame and part log construction. It is large enough for 20 or more men and is in good condition. It is situated on the north side of the river near the highway.

DEVELOPMENT: Monarch Mine

Development on the Monarch consists of approximately

3360 feet, divided as follows:-

	<u>On ore</u>	<u>On Waste</u>
Drifts	250'	0
Crosscuts	250'	525
Stoped ground on length of orebody	460	0
Short drifts and crosscuts from stope sides	0	375
Raises and inclines	<u>150</u>	<u>1350</u>
	1110	2250

A rough estimate of the tonnage of ore extracted from the stopes gives the following figures as probable; on account of partial filling of the stopes it is impossible to make an accurate estimate:-

Old Stopes	70,000 tons
New Stopes	13,000 "

The maps accompanying this report and that of Mr. Hearn show this work. The lower tunnel and raise, north-east of the N.E. end line of the Monarch Claim; the tunnel and raise between the N.E. end line of the Monarch Claim and the "Old Stope"; and the long incline between the "Old Stope" and the "New Stope" were driven in barren ground to facilitate the handling of ore and waste, and for traveling ways.

Comments on the other mine workings will be found under "Geology".

Kicking Horse Mine:

Development has been done through four tunnels, amounting to approximately 1100 feet, divided as follows:

	<u>On ore</u>	<u>On waste</u>
Drifts	310'	120'
crosscuts	95'	485'
Raises	<u>25</u>	<u>75</u>
	430'	680'

TOPOGRAPHY:

The topography is extremely rough and steep and has an unusual bearing on the development and working of the property. While all the known ore bearing areas are bare of soil and vegetation, yet they are so steep and rugged as to be entirely inaccessible except at a few isolated points where a stratum, softer than the average, has formed a bench which gives a precarious foothold.

The Monarch mine is situated on the south side of the river and on the precipitous north slope of Mount Stephens.

(Peak elevation 10,485 feet) at an elevation of 1200 feet above the valley floor; the average slope from the outcrops to the C.P.R. tracks being about 60° composed of talus slopes at the foot succeeded by vertical cliffs above.

A trail and ladders give access to both the "old" and "new" stops along the cliff but beyond the "new" stop, and above both of them, the cliffs are absolutely inaccessible along the ore bearing zone.

Access to the mine is now by trail from the concentrator over the talus slope to the north along the north shoulder of the cliff to a tunnel connecting with both the old and new workings by raises.

The Kicking Horse mine is on the North side of the river directly across from the Monarch and about 900 feet above the valley. It is reached by a trail leading first over talus slopes, then along a bench between cliffs to the No. 1, 2, and 3 tunnels.

The No. 4 tunnel is now inaccessible on account of the destruction of the ladders leading up the cliffs to it. Vertical cliffs of 100 feet, and more, are below the mine, and above and along the ore zone to the westward the cliffs are inaccessible.

There is unlimited dump room on the Kicking Horse side, but on the Monarch side ore and waste must be transported 1500 feet, or more, from the entrance of the mine before it can be stored where it will not run down on the railway tracks.

#### GEOLOGY:

The General geology of the immediate region as given by John A. Allan, C. G. S. Memoir 55, is as follows:-

The oldest rock exposed is the Lower Cambrian which consists essentially of quartzites, and has been brought to the surface on the edges of the Kicking Horse valley by a flat anticline whose axis is a few thousand feet east of the mines; it strikes NNW with a gentle pitch to the Northward.

Lying more or less conformably on this, is the Middle Cambrian, consisting of essentially calcareous and dolomitic rocks which are divided into three formations as follows; from the lowest upward;- the Cathedral limestones and dolomites in thick, massive, cliff-forming beds 1600 feet thick; the Stephen limestones, thin bedded and softer 640 feet thick; and the Eldon formation consisting of cliff forming limestones 2700 feet thick. The nearest known igneous rocks are fourteen miles distant.

Two or three thousand feet to the northeast of the Monarch Mine, the Stephen-Cathedral fault, of NNW strike, throws the lower Cambrian beds against the Middle Cambrian and has a displacement of 2000 feet, with the downthrow to the westward.

Mr. Allan also continues regarding the Economic Geology of the Monarch Mine, substantially as follows;- (At the time of his work in the district only the "Old" orebody was known.)

The ore body occurs in a band of bluish gray limestone 300 feet thick, belonging to the Cathedral formation which is at the base of the Lower Cambrian. The rock is fissured by a nearly vertical S 10° E fissure, and also by a series of cross fissures nearly east and west.



There is a well marked zone of sheared rock up to 500 feet wide, but inaccessible. It cuts diagonally across the bedding of the Cathedral limestone and pinches out on the southwest side of the Mountain 800 feet higher. In the mine workings the zone consists of a shattered mass of rock. Fragments are cemented together by calcite or ore, making the limestone band appear in places as a typical shatter breccia.

The ore minerals (galena, sphalerite, and pyrite) occur on, and near, the major and cross fissures, and also in the cementing material around them. When the lime fragments are small the ore minerals may form the larger part of the cement, or frequently impregnate the blocks themselves. Sometimes, but not always, there is enrichment at the junction of cross fissures. In places, there is replacement of the rock by ore, and pockets of almost pure galena occur. The main north-south fissure, followed for 250 feet, seems to branch into several smaller ones at the south end. A fault with small apparent displacement has cut off the orebody at this end; the upthrow has been on the south side.

The floor of the orebody is more massive silicious, dolomitic, limestone which has been less shattered about the fissure and which contains very little ore. A zone of pyrite seems to mark the lateral extent of the ore enriched rock. Sphalerite occurs often intimately associated with galena, though in places is alone. The sides of the larger fissures are usually highly oxidised, and some contain gouge. In general the ore occurs along and about a series of cross

fissures, sometimes replacing the lime, and cementing fragments of shattered rock. The ore solutions have also spread out along bedding planes on top of the more impervious underlying dolomitic limestone, giving the deposit the form of a blanket lode. The ore solutions have come up through fissures, and spread out and replaced shattered limestone in the sheared zone. It seems possible that the enrichment will continue in the same irregular manner as far as the shattered zone extends laterally and vertically.

(Original).

The Monarch and Kicking Horse workings lie on the east limb of a gentle anticline, the axis of which strikes approximately N 25° W and pitches to the northward at a small angle.

The average resultant dip is between 10° and 20° at the Monarch workings, and from 10° to 30° at the Kicking Horse, both to the northeast. The dips, however, are not uniform as the limb of the anticline is slightly "wrinkled" more or less parallel to the axis of the anticline.

Both of the known Monarch orebodies lie in gentle wrinkles, or flattened troughs, and the same appears to be true of the Kicking Horse orebody. As Mr. Allan states, they also occupy a zone of intersecting fractures; these seem to have their strongest development along the wrinkles.

A zone of brecciation, in which no bedding planes can be observed, first shows at the talus slope at the NE end of

the Monarch claim, where it is some 300 feet thick and lies directly on top of the "massive silicious dolomitic limestone" mentioned by Mr. Allan as the floor of the orebody (locally known as the "Black Lime.") It follows the top of the Black Lime to a point on the cliff some three or four hundred feet southwest of the "New Stop", where it begins to diverge upward, cutting diagonally across the bedding at an angle of about  $15^{\circ}$  and finally passes from sight, well toward the apex of the anticline, at a distance of a half a mile or more. This brecciated zone is from 200 to 500 feet thick and its outcrop is inaccessible, except where it emerges from under the talus to the N.E. The same zone shows clearly on the Kicking Horse side. It emerges from the talus north of the camp, follows on top of the Black Lime to a point midway between the No. 3 and 4 tunnels, where it diverges and passes diagonally through successively higher strata. On the Kicking Horse side faint bedding or shearing planes may be seen in this zone near the talus north of camp.

It is rather evident that the brecciation is later than the folding, and it probably is in some manner connected with the Stevens-Cathedral fault, possibly through adjustments of strains during the faulting.

#### DESCRIPTION OF MINE WORKINGS.

##### Monarch Mine.

The tunnel at the NE end of the Monarch Claim is started in thin bedded Black Lime and passes through it into more massive Black Lime. The raise at the end passes

through the same rock and encounters the breccia zone eleven feet below the "Old Stope." The top of the Black Lime also shows in the cliff just under the north end of the "Old Stope", and in a crosscut at the SW corner. A flattening of the dip is evident, both on the face of the cliff and underground, in the vicinity of the stope, although there is little actual troughing of the strata. No ore remains around the Old Stope which is now partly filled with waste.

A prominent system of vertical fractures extends in a SSE direction through the center of the stope, but weakens and becomes lost near the south end.

A system of vertical ENE fractures appears nearly as strong, but shows stronger in the walls than in the back of the stope. There are also other strong fractures traversing the stope at various angles. These various fractures sometimes end on each other, sometimes cross without dislocation, but have a tendency to become lost in generally shattered ground near the center of the stope. They are apparently of later origin than the ore, or at least there has been post mineral re-opening of them.

Mr. Allan's statement that the south end of the stope has been faulted does not seem to be borne out by the present exposures.

It is to be presumed that the amount of brecciation around the margins of the stope is less than that in the ore; a decrease is noticeable in the various crosscuts driven in the sides of the stope, except along and near the main fracture planes

Strong brecciation is still in evidence 75 feet NW of the foot of the incline to the New Stope, at the center of the south end of the stope, and at various points in the back. In the back of the stope the limestone is a grayish white, much lighter than the ore bearing blue-gray limestone in the lower parts. There is, however, no definite demarcation between them. The raise at the SW corner of the stope shows almost unbrecciated white limestone near the top.

Upward from the foot of the incline between the two ore bodies, white limestone is exposed for 325 feet; there is generally a slight coarse brecciation, notably at about 75 feet, which has been healed by calcite. There is also a little fissuring, but no ore minerals except rare grains of pyrite. At 325 feet Black Lime appears in the bottom dipping  $18^{\circ}$  NE, and continues on the dip, with a sharply defined contact to 350 feet, where the contact becomes broken and uneven, and suddenly turns upward, going out the back of the incline before the 360 foot point is reached. From 360 to 390 feet the incline is in slightly brecciated Black Lime in which no bedding is to be observed. At about 400 feet bedding appears in rather massive black lime dipping  $13^{\circ}$  NE, but gradually flattens to the 450 foot point where it begins to dip a few degrees to the SW. At 475 feet the thin bedded Black Lime is encountered dipping slightly SW, but gradually turns to  $12^{\circ}$  NE at the head of the incline. In the raise from the incline the bedding is again gently SW and the contact with the ore bearing limestone is encountered 20 feet below the floor

of the new stope.

Just what happens to allow the overlying 40 feet, and more, of Black Lime to suddenly pass through the incline (between the end of the white lime and the bedded part of the Black Lime) is not clear, but it may be a combined bending and shearing action; there is no evidence of definite faulting. This disturbed condition extends through to the surface at 200 feet NE of the "New Stope."

In the "New Stope", and contiguous workings, Black Lime appears in the raise from the incline, as before mentioned, at the north end of the stope, just west of the winze, and on the face of the cliff just below the stope. A shallow troughing of the strata is evident. A few thousand tons of ore has been taken from the north end of the orebody which appears to have been as much as 40 feet thick in places. The stope is now partly filled with ore from development. A small amount of ore remains on the sides of the stope and at several points in the back, as well as in the entirely unstoped part to the southward.

The south west cross cut from the north end of the stope is all in ore to the foot of the raise; some of it contains and unusually large proportion of sphalerite and pyrite; the limestone is also unusually white for an ore container. The raise shows fairly brecciated white limestone, but no ore. At the head of the raise from the incline no ore remains on the east side of the stope.

The main south drift is in very good ore for most

of its length, but the intensity of brecciation is decreasing near the foot of the raise, on account of the probable approach to the bottom of the orebody, which has a northwesterly pitch. The east crosscut from this drift is in ore except near the east face, where it is nearly barren, and the brecciation decreasing; it has probably passed the east side of the orebody.

The raise at the end of the drift is in ore as is also the south drift at the top of it, but near the south face of the drift the ore is again becoming lean. The raise at the extreme south end shows 55 feet of ore, but the crosscut to the southwest from the top is in waste except that some ore appears in the floor; it was apparently started a little too high.

The crosscut southwest from the south drift (Elevation 5360 feet) is in ore practically to the end although the last few feet are low grade, with a tendency for the best ore to occur in the back.

HNW vertical fractures and suggestions of parallel shearing are to be found throughout the orebody but they are not as pronounced as those in the "Old Stope". The east-west fractures and fissures are stronger and more frequent, reversing the observed conditions in the "Old Stope". Neither system has any very certain connection with the ore deposition, although the brecciation seems more intense near them. As in the "Old Stope", the ore mostly occurs in a bluish-gray limestone, and above it is a partially mineralized grayish white limestone. The galena has a tendency to lie in the center of the orebody.

with sphalerite and finally weak pyrite predominating around the sides and ends.

Kicking Horse Mine.

The No. 1 Tunnel (lowest) is a crosscut through the Black Lime for 100 feet, where it encounters the breccia zone, the contact striking NW and dipping  $25^{\circ}$  NE. The contact is a 4 or 5 foot zone of rounded fragments and gouge, with sheets of tremolite, but does not show evidence of much movement, but rather solution. The tunnel has continued a further 100 feet and shows some zinc with spots of galena, which are probably too low grade to constitute ore. A short raise from a 40 foot drift SE is said to show 5 feet of ore, but this was not confirmed as the raise is filled. In the ore bearing zone there is considerable brecciation but not as intense as is usual where ore occurs.

The main No. 3 tunnel is in ore to the face except for a few feet where the Black Lime of the foot wall is encountered, and at the last turn. At the point where the Black Lime is cut, a ENE fissure faults the contact a few feet. A southwest crosscut from this tunnel enters the foot wall Black Lime at 35 feet and continues in it to the face. Two raises have been driven, the first showing about 22 feet of ore, and the second a few spots of ore, only. The latter also exposes the Black Lime contact which strikes Northwest and dips  $14^{\circ}$  NE. Brecciation is fairly intense throughout the ore-zone, as exposed in the tunnel, including the barren area near the end. The predominating fractures are vertical and strike NE; there appears



to be slightly leaner ore than the average along them. NNW fractures such as are prominent in the "Old Stope" of the Monarch are scarce and very weak.

The NE-SW part of the No. 2 tunnel has been driven along a strong semi-open fissure; ore shows along the SW part of it. The NNW part of the tunnel shows ore for 40 feet from the portal, then waste with considerable pyrite, and again shows low grade ore up to the NE fissure.

This ore body does not appear to lie in a trough but there is evidence of a flattening of the dip there. Sphalerite and pyrite appear stronger around the margins of the ore body.

#### THE ORE:

There is no essential difference between the Monarch and the Kicking Horse ores, except that the latter contains more zinc as compared to the lead.

The brecciated areas have been recemented by calcite, galena and sphalerite. The smaller fragments of limestone have also been replaced and impregnated by sphalerite, galena, and pyrite in decreasing amounts according to the order named. Certain well brecciated areas have been cemented by calcite alone but these are generally along the margins of the ore bodies. The galena is generally fairly coarse grained and contains small quantities of silver; it does not appear to have replaced limestone to the same extent that the sphalerite has, but has acted more as a cement. The sphalerite is resin-yellow in color, and has both cemented and replaced

the limestone fragments. Pyrite has replaced the fragments rather than cemented them.

Calcite has apparently been deposited at two periods, the first associated with lead and zinc as a cementing medium in the breccia, and second with little lead or zinc as healing secondary fractures.

**ORE OCCURRENCE:**

Development to date has indicated that the ore bodies (1) occur in troughs on the East dipping leg of the antiline, or at least, where the dip is flatter to the NE than the average; (2) in zones of intense shattering which coincide with (1); (3) near strong comparatively recent fissuring, which is probably governed by (2); (4) their greatest elongation is NNW with a gentle pitch downward in the same direction, and in cross section they are roughly elliptical with the greater dimension slightly inclined with the dip of the strata; (5) they occur solely within the brecciated band before mentioned as cutting across the mountains on both sides of the river.

It is presumed that other ore bodies may be found at other points where similar physical conditions prevail.

Such a location is probable along the strike of the present known orebodies. The "wrinkle" in the strata persists beyond the ore now developed; and the general breccia zone should extend for long distances to the NNW in the Kicking Horse and SSE in the Monarch; there is, however, no means of determining the presence or absence of the intense brecciation which seems necessary to the presence of ore, without underground

work.

A study of the Monarch cliffs with glasses from the Kicking Horse side, shows a gentle flattening of the strata some 250 feet north east of the New Stope. This is also indicated in the main incline, between the Old Stope and the New Stope, by the observed dips of the bedding in the Black Lime.

At 300 or 400 feet southwest of the New Stope a rather pronounced flattening or gentle troughing of the strata occurs, and in the brecciated zone above it there is some iron stain, and an apparent change in the texture of the rock which probably indicates an area of intense brecciation and of mineralization. Float ore is reported from the talus directly below this point.

Perhaps a thousand feet further southwest, there also appears to be a favorable position for ore but on account of the distance and the angle of vision it is more indefinite; at this point the breccia zone lies several hundred feet above the Black Lime, so the conditions are not entirely similar.

On the Kicking Horse side, a favorable locus for exploration is midway between No. 3 and 4 Tunnels, where at least some of the necessary conditions obtain.

On account of the shape of the ore bodies and their relation to the accessible part of the surface, it is not feasible to diamond drill from the surface, and underground tunneling must be resorted to for both exploration and development. From such underground workings, short drill holes may be used to

advantage in locating possible ore bodies nearby, as, for instance, in the main incline of the Monarch a drill could be used to advantage to explore the ore bearing zone below the lower part of the incline, and above the upper part.

Since the three known ore bodies lie from 0 to 40 feet above the Black Line exploratory work should, for the present be confined to that horizon.

Since the long dimension of the known orebodies is ENW, exploratory work should be carried on in a SSW direction, or upward along the dip. If this work should prove successful exploration might be also carried on down the dip and under the talus.

#### SAMPLING;

Nearly 250 samples were cut in the two mines and assayed for silver, lead, and zinc. The details of the sampling and the average value of the ore should be obtained from Mr. Hearn's maps and report.

#### ORE DEVELOPED;

At this writing Mr. Hearn's figures as to ore developed are not at hand, and the writer has not made an independent computation of the average values, but offers the following outline as his idea of the proper method of obtaining the quantity of ore.

#### Monarch Mine.

The area indicated by the sampling to be ore is outlined on the "Plan of the Monarch Mine", and amounts to 40,600 sq. ft. There is no reason to suppose that there will

be any radical variation from the indicated boundaries on the east or west, but there should be an indeterminate, though probably considerable, extension of the ore to the south which cannot, however, be estimated as even "Possible ore."

The thickness of the ore outlined in plan is impossible to estimate accurately on account of lack of vertical development. An average thickness of 25 feet is probably a safe figure, making something over 100,000 tons of "Probable ore", fairly well determined, the exact tonnage depending on the specific gravity of the ore as determined by test.

#### Kicking Horse Mine.

The indicated ore area is outlined on the Plan of the mine. The west boundary of the ore, along the Black Line contact is fairly certain, but on the northeast side the boundary is quite uncertain. To the northwest, it would appear that the ore is ending, but there is a possibility that the low grade material at the last turn in the drift is merely a local impoverishment of no particular meaning.

There is very little data on which to estimate the average thickness of the ore; what little there is would indicate a thickness of not less than 22 feet. The area as drawn (20,500 sq. ft.), over this width will give a tonnage of approximately 50,000 tons which could be a safe figure for "Probable Ore."

#### RECOMMENDATIONS;

The following development is recommended as most advisable for the present:

(1) Provide safe mechanical means to convey men between camp and mine in safety against snow slides and falling rock, and to obviate the present arduous climb on foot.

(2) Block out and fully define the limits of the "New Stone" orebody of the Monarch and the orebody on the Kicking Horse.

(3) Explore, by drilling from the main incline, for new orebodies between the Old and New Monarch.

(4) Advance the Main incline some four hundred feet on top of the Black Line to explore for the prospective new orebody SW of the New Monarch.

**CONCLUSION;**

The two properties contain a considerable tonnage of semi-developed milling ore, but this ore, unless more can be developed, does not make a particularly enticing proposition. The prospects of developing additional bodies of ore are good, and warrant the expenditure of a very considerable sum of money in exploration work.

The mines have sufficient prospective value to warrant a substantial purchase price, provided sufficiently long terms can be obtained to allow for adequate exploration and development.

Respectfully submitted,

Chas. C. Starr