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Monarch Mine

Report

1928

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*Starr*

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

To Mr. E. A. Julian, General Manager,  
Goldfield Consolidated Mines Expl. Co.

By. Chas. C. Starr,  
January 22, 1928

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**INTRODUCTION:**

On account of snow conditions an examination attempted this month had to be given up.

This report is therefore based on some ten days work at the mines by the writer in November 1926, and the sampling of the Porcupine Goldfields Development and Finance Co. Ltd. which was done at the same time and with the details of which the writer is familiar.

Little surface study was possible on account of snow and the exceedingly precipitous topography.

**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; The Kicking Horse and other claims, held by location, besides nearly two square miles of mineral rights, and approximately 17 acres of surface rights under lease from the Dominion Government.

These are under lease and bond from W. E. Narkaus and associates 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, B. C.

Freight on ores and concentrates from Field to the Trail Smelter is \$5.00 per ton based on a value of \$50.00 per ton, with a differential of 30 cents per ton for each \$10.00 increase in value.

Freight charges to Vancouver are not much different.

**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.

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 one 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 now partially dismantled aerial tram leads 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.

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	575
Raises and inclines	<u>150</u>	<u>1360</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 show this work. The lower tunnel and raise, northeast 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".

Ricking 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> 430'	<u>75'</u> 660'

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 March 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" stope along the cliff but beyond the "new" stope, 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 3000 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 Stope", where it begins to diverge upward, cutting diagonally across the bedding at an angle of about 15° 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 Stephens-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 extend 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. Whatever may have been the period of their origin, there has been post mineral reopening with sometimes the development of a small gouge and slight oxidation of the galena.

Where observable at all in the Black Lime, they are small and tight, but fairly open in the overlying strata. There is little or no evidence that ore has "made" along them, individually at least, in any direction from the main orebody.

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 crosscut from the north end of the stope is all in ore to the foot of the raise; some of it contains an 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 northeasterly 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 35 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.

ENE 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° 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 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 differences 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 anticline, 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 NNE, 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 AND AVERAGE VALUES:**

Nearly 250 milled samples were cut in the two mines for the Porcupine Goldfields Development and Finance Co., and assayed at the Stenwinder Mine, Kimberley, B. C.

Approximately 4 lbs. of rock per foot was taken and the job was carefully done. The detailed results appear on the assay maps herewith, which are authentic copies of those of the Porcupine Co.

None of the samples cover the full thickness of the orebody since the ore is always thicker than the height of the drifts, except possibly in rare instances on the margins; the "width sampled" therefore has no particular significance.

Monarch Mine: In obtaining the estimated average value of the ore, all assays were averaged according to their widths, except the following:

Nos. 222 to 227 are omitted because they were taken along the face of a strong fissure where there was an unusual concentration of galena; fourteen other samples taken beyond the margins of the ore in the east crosscut, the face of the



south drift, and the face of the S-W drift.

The average value resulting is:

<u>Ft. Width</u>	<u>Oz. Silver</u>	<u>% Lead</u>	<u>% Zinc</u>
6.56	1.17	11.36	6.98

As a matter of comparison it is reported that other results obtained are:

Federal Lead Co.	1.36	12.3	6.2
Pacific Mines Ltd.	1.00	12.5	7.5

As an additional check on the sampling, 10 large samples taken under the supervision of W. H. Grant are cited as follows:

<u>Porcupine Co.</u>			<u>W. H. Grant</u>	
Number	Lead %	Zinc %	Lead %	Zinc%
128	24.8	1.8	23.4	1.3
142	25.6	1.0	21.2	0.1
166	11.2	11.6	10.9	8.9
180	14.2	12.0	21.1	4.1
187	25.0	10.7	27.7	15.4
198	1.2	23.0	0.3	11.2
204	1.0	21.5	6.0	20.0
230	22.0	2.5	18.4	4.9
235	10.0	14.8	5.6	32.9
239	3.6	19.0	10.2	23.6
Av.	13.9	11.8	14.5	12.2

Kicking Horse Mine: In calculating the average value of the orebody, 12 samples were omitted, - 2 in Billy's tunnel, 1 in #3 crosscut, 2 in #2 raise and 7 on the two sharp bends in #3 tunnel. The result obtained is:

<u>Width Feet</u>	<u>Silver Oz.</u>	<u>Lead %</u>	<u>Zinc %</u>
6.18	2.09	3.90	12.80

Sampling by other companies resulted as follows:

Federal Co.	3.75	7.2	17.2
Pacific Mines Ltd.	2.50	6.4	16.2

This is not as close a check as was obtained on the Monarch; it is not evident how much of the discrepancy is due to sampling error and how much to different handling of the data obtained.

ORE DEVELOPED:

Monarch Mine: The area indicated as ore by the sampling is outlined on the "Plan of the Monarch Mine" and contains <sup>37,300 square feet</sup> 37,300 square feet. There is no reason to suppose there will be any radical variation from these boundaries on the east or west, but there should be an indeterminate, though probably considerable, extension of the ore to the south which cannot properly be estimated as even "Possible Ore".

The thickness of the ore outlined in plan is impossible to estimate accurately on account of lack of sufficient vertical development.

The full thickness of the orebody is exposed at three points only (40, 22, and 20 feet) which give an average of 27 feet.

Since these thicknesses are more or less along the center of the ore they are probably more than the average. In the tonnage estimate, below, 22½ feet average thickness is used, and a factor of 9 cubic feet of ore per ton.

The tonnage developed on the above basis is 93,250 which may be considered as fairly assured ore. There is a further tonnage expected from the same orebody which is not now possible to estimate.

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 rather 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.

There is very little data on which to estimate the average thickness of the ore; this little would indicate a thickness of not less than 22 feet. The area as drawn is 18,800 sq. feet. giving a tonnage of 45,900 tons of fairly assured ore.

Combining the calculated ore in the Monarch and Kicking Horse gives 139,000 tons averaging 1.47 oz. silver, 8.88% lead and 8.90% zinc per ton.

A somewhat higher grade of ore can probably be obtained by leaving the lower grade parts of the orebody around the margins and as pillars.

**NET VALUE OF ORE:**

Several tests have been made on the ore to determine its amenability to concentration.

The following is a record of one reported as made by the Federal Lead Co. by flotation:

	<u>Weight</u>	<u>Oz. Ag.</u>	<u>%Pb</u>	<u>%Zn</u>	<u>Fe%</u>
Crude Ore	100.	2.3	11.0	10.2	2.5
Lead Conc.	13.65	11.7	75.6	6.1	.2
Zinc Conc.	16.00	3.6	1.95	56.6	1.2
Tails	70.35	.22	.51	.44	

**Recoveries %**

Lead Conc.	69.3	93.8	8.2
Zinc Conc.	25.	2.8	88.8

These results are reconstructed for the value of the average Monarch and Kicking Horse ore on the assumption that the grade of the lead and zinc concentrates are the same, and the recovery the same, but with a changed ratio of concentration, as follows:

	<u>Weight</u>	<u>Ag. Oz.</u>	<u>%Pb</u>	<u>%Zn</u>
Crude Ore	100%	1.5	8.9	8.9
Pb Conc.	11.1	9.3	75.6	6.1
Zn Conc.	14.0 ✓	2.7	1.95	56.6
Recovery % Lead in Pb Conc.		93.8%		
" " Zinc in Zn "		88.8%		

Figured on the Consolidated Mining and Smelting Co.  
smelter schedules the concentrate will have the following value:

Lead Cons.

Silver	@ .58	\$5.10
Lead	@ \$22 per long ton	<u>48.12</u>
		\$53.22
Treatment	@ 8.00	
Sulphur	2.00	
Zinc	1.22	
Freight	<u>5.00</u>	<u>16.22</u>
Total value per ton concentrate		\$ 37.00

Zinc Cons.

Zinc	@ \$ 25.88	28.86
Treatment	5.50	
Freight	<u>4.40</u>	<u>9.90</u>
Total value per ton concentrate		\$ 18.96

Value of concentrate F.O.B. cars, per ton of ore

Lead	Wt. 11.1% of crude	\$ 4.11
Zinc	Wt. 14.0% of crude	<u>2.65</u>

Value of concentrate from one ton of ore 6.76

Value of concentrate from 139,000 tons of ore \$934,000.00

As noted under "Ore Developed" it would probably be possible to mine a somewhat higher grade of ore; the effect of this on the net value per ton is indicated below. Assuming a crude ore content of 2.3 oz. Silver, 12.0% lead and 10.0% Zinc, the value of concentrates from one ton of ore would be:-

Lead Conc.	\$ 5.69
Zinc Conc.	<u>3.39</u>
	\$ 9.08

If the Monarch Mine be considered alone, the ore, on the same basis as above will have a value of \$7.06 per ton.

The Kicking Horse mine along will have a value of \$6.15 per ton.

ESTIMATED COSTS:

Based on a production of 200 tons per day.

Equipment:

Mine equipment covering compressor, internal combustion engine, etc., drill sharpening equipment, drills, steel, etc. laid down at mine....	\$ 35,000.
Cars, Track, Pipe, etc.....	5,000.
Labor, installing above and making mine ready for operation.....	<u>10,000.</u>
	\$ 50,000.
Mill equipment covering, 200 ton oil concentration plant, complete except building and foundations, by Mr. Frank Richelberger.	100,700.
Building and Foundation.....	<u>15,000.</u>
	\$ 115,700.
Other equipment covering tramway to Monarch Mine, camps, etc.....	<u>7,500.</u>
Total Monarch Equipment Cost.....	\$ 173,200.

Operating:

Mining, covering breaking, mucking, tramming to mill, etc. except development, per ton.....	\$ 1.40
Development on present orebody only, per ton.....	.05
Milling, covering all milling operations.....	1.35
Overhead, taxes, interest on equipment, insurance etc.....	<u>.65</u>
Total cost per ton.....	3.45

The above equipment and operation costs are based on the immediate operation of the Monarch Mine only.

If the Kicking Horse should also be equipped for immediate operation it would add about \$20,000. to the equipment cost.

Operation of the two mines simultaneously would make an addition to the operating cost of perhaps 25¢ per ton.

PROFIT AND LOSS:

Monarch and Kicking Horse

Value of ore 139,000 tons at \$6.76	\$ 939,640.
Equipment Cost	<u>193,200.</u>
	746,440.
Operating cost 139,000 tons @ \$ 3.70	<u>514,300.</u>
Profit exclusive of property purchase	232,140.
	Per Ton \$ 1.67

Monarch Only

Value of ore 93,250 tons @ \$ 7.06	658,345.
Equipment Cost	<u>173,200.</u>
	485,145
Operating Cost 93,250 tons @ \$ 3.45	<u>321,712.</u>
Profit exclusive of property purchase	163,433.
	Per Ton \$ 1.75

DEVELOPMENT RECOMMENDATIONS:

The following development is recommended on  
The Monarch:

1. Provide safe mechanical means to convey men between mine and camp in safety against snowslides and falling rocks and to obviate the present arduous climb.
2. Block out and fully define the limits of the "New Stope" orebody, with especial attention to its extension to the south, and its thickness.
3. Explore to the south of the "Old Monarch" stope, along the "trough" and the brecciated zone.
4. Explore, by drilling from the Main Incline, for a new orebody below the New Monarch where the strata flattens.
5. Advance the Main Incline some 400 feet on top of the Black Lime to explore for the prospective new orebody SW of the New Monarch.

On the Kicking Horse side it is recommended to:

1. Block out and fully define the limits of the present orebody.
2. Explore beyond the northerly limit of the orebody.

CONCLUSION:

Under "Ore Occurrence" several favorable locations for the occurrence of virgin orebodies are given, and it is my belief that development will prove the existence of at least part of them. It is also to be confidently expected that the



"New Stope" orebody will prove to extend a substantial distance further to the south. It is probable that development to the south of the "Old Monarch" orebody will also result in the finding of further ore there.

On the Kicking Horse further development of the known orebody should result in a substantial increase in its size beyond what is now indicated, and there is a good chance of finding other ore by further exploration.

Therefore, I consider that the mines have a very material prospective and intangible value in addition to the tangible value of the ore now developed.

According to the above estimates, the profit from working 63,000 tons of average ore, which should take a little less than a year's time, will repay the equipment cost, leaving \$3.06 per ton from the remaining 76,000 tons to apply against the purchase price of the property and as profit.

On the basis of the ore now developed only, without taking into consideration the expectation of developing more ore, the cash value of the mine may be taken as about \$100,000. - which I consider a liberal figure.

As to the value of the expectation of further ore, no definite price can be set. However, I consider the prospects excellent for developing a large tonnage, and recommend that the two mines be purchased if a reasonable price be obtainable.

I consider a reasonable price to be \$100,000 plus

further amounts in deferred payments of such size that  
the gamble on future development be assumed in part by both  
seller and purchaser.

Respectfully submitted,

*Chas. C. Starr*

ADDENDA:

1. Re - Possibility of selective mining to raise average value to estimate of Mr. Eichelberger, and its effect on tonnage and profits:

Monarch:

There is no indication from the assay map that any considerable area may be eliminated from the ore area as being too low grade to mine. As a matter of opinion, it is probable that low grade spots will be found during mining which may profitably be left as pillars.

Since Mr. Eichelberger's estimate is higher than mine by only 0.1 oz. silver, 1.1% lead, 0% zinc, the leaving of 5000 tons of low grade material would account for the difference and bring the value up to Mr. Eichelberger's estimate of 1.3 oz. silver, 12.5% lead, and 7% zinc.

It is reasonable to believe that this can be done without difficulty.

Kicking Horse:

My memory does not check Mr. Eichelberger's statement that the ore only comes part way down the side of the drift, - as I recall it does come all the way down except perhaps at one or two samples.

The average of the samples on the west or footwall side of the drift is 5.2% lead and 12.3% zinc, while that of

the east side is 4.0% lead and 13.5% zinc which also tends to refute this statement.

By cutting off the NE end of the area, previously figured as ore, at sample #28, a tonnage of 40,800 containing 2.4 oz silver, 4.0% lead and 14.6% zinc results. I do not see that an essentially higher value can be properly obtained on the basis of the Porcupine Goldfields samples, since if the calculated ore be cut off between No. 2 tunnel and Billy's tunnel there will only be a very small increase in value in the remaining ore.

We now have: -

Monarch	88,250 tons	1.3 oz.Ag.	12.5% Pb	7.0% Zn.
Kicking Horse	<u>40,800</u> tons	2.4	4.0	14.6
Both Mines	129,050	1.65	9.81	9.37

The value of the concentrates will be as follows, per ton of ore: -

Monarch .....	\$ 7.55
Kicking Horse	6.83
Monarch & Kicking Horse Mines	7.32

with silver at 58¢, lead at \$22, and zinc at \$25 a8.

Monarch and Kicking Horse

The value of 129,000 tons at \$ 7.32	\$ 944,280.
Equipment Cost	<u>193,200.</u>
	751,080.
Operating cost 129,000 @ \$3.70	<u>477,300.</u>
Profit exclusive of property purchase	\$ 273,780.
	Per ton \$ 2.12

Monarch

Value of 88,250 tons at \$7.55	\$ 666,287.
Equipment Cost	<u>173,200.</u>
	493,087.
Operating Cost 88,250 tons at \$ 3.45	<u>304,462.</u>
Profit exclusive of property purchase	188,625.
	Per ton \$ 2.14

With the milling equipment charged to the Monarch, the Kicking Horse mine should be operated for approximately \$3.70 per ton plus 23¢ per ton for special equipment, or \$3.93 per ton. This would leave a profit of \$2.90 per ton on the basis of ore values as in Addenda 1, (page 2) or \$1.40 per ton profit after royalty of \$1.50 is paid.

2. Re Variation in value of ore from varying price of lead and zinc.

On the average given for the two mines in Addenda 1, 1.7 oz. ag., 9.8% Pb, 9.4% Zn., an increase in the price of lead

of 1 cent will increase the value of the ore \$1.69 per ton.

An increase of 1 cent in the price of zinc will increase the value of the ore \$1.41.

A decrease in the price of 1 cent on either metal will decrease the value the same amounts as given.

A variation in price of several cents a pound will vary in nearly the same ratio, but not exactly, on account of freights changing according to the value of the concentrate.

3. Re Advisability of paying \$175,000. for a three quarters interest in the Monarch with an option for two years on the remaining quarter at \$125,000.

Using the figures of page 27, the profit, exclusive of property payments, from working the now developed ore is \$163,433. At a cost of \$175,000. for a three quarter interest there would be a loss over equipment and operation of \$ 11,567. plus a loss of 1/4 of \$1.75 per ton, operating profit 41,030.  
52,597.

The total development to date at an assumed cost of \$15 per foot has developed the present ore at a cost of 54 cents per ton.

Applying this cost to future development we have:

Development	\$ 0.54
Operating	<u>3.45</u>
	3.99

leaving an operating profit on new ore developed of (\$7.06-3.99) \$3.07. The tons of new ore, of the same value per ton, required

to offset the loss in purchasing a 3/4 interest is:

	17,000 tons
To cover a 1/4 interest at \$125,000	<u>40,700</u>
Approximate new ton- nage required to own mine, clear	57,700

Note that if the figures for the Monarch in Addenda 1 are used the present ore will give sufficient profit over equipment and operation to make the \$175,000 payment.

There is hardly room to doubt that this amount of ore can quickly be put in sight with a limited amount of development and a large further amount is to be confidently expected by continued work in the present ore channels, and in those which should be opened by further work.

I believe the price of \$175,000. cash for a 3/4 interest and option of 2 years for the remaining 1/4 at \$125,000. is justified. I believe there is a good possibility that this payment can be made up by profits on the present Monarch ore, if lead and zinc prices remain at the present level, certainly so if higher, and I am very optimistic regarding the future possibilities of the property.

My figures as to ore values, costs and profits are, I believe, conservative and I would expect a somewhat greater profit than I have calculated.

*Thos. C. Starr*

Mr. Grant's Observation on Mr. Starr's Report

Page 9 - There is no fault at south end of west Monarch. orebody. Allen arbitrarily assumes a fault because the good ore stops there.

Page 12 - There is prominent fissure in south end of Old Stope.

Page 15, Paragraph 3 - Apparently Mr. Starr is confused and uncertain in his observations and interpretation of the fissures. The evident facts are that the folding of the formations into an anticline, the big faulting (e.g., The Cathedral) the observable intense abundant longitudinal and cross fracturing and brecciation were predominately premineral. The introduced mineralization ascended along the intersection of some of the cross with longitudinal fissures. This replaced large bodies of brecciated limestone which loosely occupied the share of the present orebodies and filled the cavities and fissures which were present in that space. Post-mineral fracturing took place - generally along the lines of old premineral fractures (but not necessarily so) through the orebody. Therefore the observable fractures in the orebodies are all post-mineral. Their continuity and strength does not necessarily indicate the continuity and strength of the premineral fractures. The position, quantity and grade of ore are the predominate indicators of the strongest premineral fissures.

The relative positions of galena, sphalerite and pyrite, will not be the same throughout all part of the long flat orebody.



Page 21-23 - Based principally on the statement of Mr. Watson that the ore which he stoped from the West Orebody averaged about 25% combined metals and the average of 4000 pounds of the rejects from the Federal samples, it is my deliberate opinion that the Monarch and Kicking Horse orebodies will mine at least 20% combined metals and probably more with normal care in mining ore only.

As Mr. Starr's total developed tonnage is approximately equal to that represented by Mr. Eichelberger there is little need to quibble over the details. In general, however, in continuous orebodies of this character, a conservative engineer would be justified in estimating as ore - in sight - at least 50 ft. beyond a line connecting the two development faces of the West Monarch Orebody.

Page 29 - It is unsound economics to place a value on a mine without considering its potential possibilities. The potential possibilities of the Monarch and Kicking Horse Orebodies are so great and so quickly developable by extending development faces, which are now in ore, along the trend of the ore that a high value should be placed on it especially when terms are easy.

Notes on Mr. Starr's Report on Monarch and Kicking Horse Mines

By Frank Eichelberger

Page 3, under the caption of Power - Permission has been secured for development of water power if desired. This lease will be found among the documents presented.

Page 3a, - No mention is made of two water power driven compressors which are installed in the small building just to the east of the mill. The water for these is available from May until November. They are in good shape and would furnish about 350 feet of air per minute.

Page 5 - Under caption Monarch Mine - Mr. E. W.

Watson whom Mr. Grant had employed in several examinations and who assisted in the examination of the Monarch, reported that he had operated the old concentrator and that approximately 100,000 tons of ore was mined from the east orebody, and that the combined metal values were almost 30%, and in the ore mined from the west ore body the combined values were approximately 25%.

Page 15 - Mr. Grant in his report to me lays great emphasis upon the longitudinal fracturing and contends that this is a dominating ore control factor in conjunction with its crossing a lime bed directly above a carbonaceous dolomite; that all development work on the horizon of these two stopes should be conducted along these fractures and that the cross-fracturing mentioned by Mr. Evans and Mr. Starr is so pronounced that a prediction where these cross fractures will intersect the longitudinal ones can be made with great accuracy.

Mr. Grant and myself also observed that the richest part of the orebody was along the cross fracturing and getting leaner between the fractures. We also noted, and our observation was confirmed by Mr. Watson's experience, that the ore was highest in lead along the top of the stope.

Page 20 - under sampling - Noting on the assay plan map of the Monarch a width is shown of 130 feet; a length of 315 feet, and taking Mr. Starr's width of  $22\frac{1}{2}$  feet, this would give approximately 102,000 tons. Excluding the samples irrespective of grade where outside of this limit and making no allowance for the drifts or raises which have been driven, as this broken ore is left in the stope, this tonnage seems to be quite accurate in its value of 1.3 oz silver, 12.5% lead and 7% zinc.

In my measurement of the Kicking Horse Mine orebody I took 16,000 sq. ft., which would give a tonnage of nearly 40,000. As the Federal and Pacific Mines results were so nearly the same, and by averaging the northeast drift samples of the Porcupine, allowing 30% as waste due to the ore coming to halfway down in the drift, the values arrived at by me are, 2.6 oz silver, 6.4% lead, and 15.8% zinc. The average for the two orebodies would then be 2.7 oz. silver, 10.4% lead, and 9.5% zinc. These values are slightly lower than the result of the Federal sampling, and higher than the Porcupine, but closely approximate the average of all three.

Taking these values as a basis for computation of the economic value of the orebody, and as a basis for metallurgy the Federal results, we get a value of \$5.46 for lead and \$2.24 for zinc for each ton of ore in the Monarch orebody, and for the Kicking Horse orebody a value of \$3.60. In the Monarch orebody I took the same figures as Mr. Starr for mining and milling, except that I allowed but 30¢ per ton for development, as we are considering only the value of the ore in sight, and as 30¢ per ton would allow \$30,000. for development work without giving any credit for ore mined during this development work, I think this is ample when it is noted that but 650 feet of work was necessary to develop this orebody. \$30,000. would probably accomplish between 2500 and 3000 feet of work, and as you would start working on ore faces in order to put more ore in sight, I think this figure is large enough.

I note in Mr. Starr's results that there is some discrepancy in his value of the zinc concentrates, probably due to a slight mathematical error.

Taking the Monarch Mine as outlined, there is a net profit of \$365,000. and in the Kicking Horse, a profit of \$144,000. after paying royalties as per attached sheet. This is considerable in excess of Mr. Starr's estimates, but I feel they more nearly represent the value of the property.

Any enhancement in price of metals would, of course, vary these figures greatly. Also if the same thickness is assumed throughout the Monarch orebody as is exposed where the ore has been stoped the tonnage would be increased about 50% or more.

Monarch Mine - Assumption 100,000 tons

Assay value 1.3 oz. ag. - 12.5% Pb - 7.0% zn.

Ratio of concentration for lead 6.4 into 1 - for zinc 9.1 into 1

6.4 x 1.30 x 69.3% = 5.7 oz. ag.  
 6.4 x 12.50% x 93.8% = 75.0% Pb  
 9.1 x 7.0% x 88.8% = 56.6% zn.

5.7 x 95% = 5.4 oz. x 58¢ = \$ 3.13  
 75% - 1¼ x 92½% = 1364 x E 22 - 1364 x (4.77¢ - 1¼) 48.01  
 51.14

Charges - Smelting \$8.00 Sulp. 2.00 - Zinc 1.22 Lime  
 Freight \$5.00 - 16.22 etc .12

51.26  
 16.22  
 6.4 ÷ 35.04 = \$5.47 \$ 35.04

56.6% x 20 = 1132 x 85% = 962  
 962 x (26-1/8 - 2½¢) = 962 x (5.65 - 2.50) = 30.30  
 Charges Smelting \$5.50 Freight \$4.40 9.90  
 20.40

9.1 ÷ 20.40 = \$ 2.24  
 Total 7.71

Mining & Milling 3.65  
 4.06

100,000 tons x 4.06 = \$ 406,000.

Capital expenditure 175,000.  
 231,000.

Cost of Mine 3/4 Int. 236,000.

Loss 5,000.

Kicking Horse 137,000.

Profit 132,000.

1/4 Interest of Trites 125,000.

Net 7,000;

Kicking Horse -40,000 tons

Assay Value - 2.6 oz. ag. 5.6% Pb 15.8% zinc.

Concentration Ratio for lead 14.3 into 1 for zinc 4.12 into 1

14.3	x	2.6	x	69.3	=	37.7 oz. -	x	95%	x	58¢	\$	22.01
14.3	x	5.6%	x	93.8	=	75% lead						<u>48.01</u>
												70.02
Charges as above												<u>16.10</u>
												53.92

53.92  $\div$  14.3 = \$ 3.77

4.12 x 15.8 x 89.9 = 58.2%

58.2%	x	20	=	1164	x	85	=	989#	x	3.15	\$	31.12
Charges smelting and Freight												<u>9.90</u>
												21.22

21.22	$\div$	4.12	=	\$ 5.15
		Total		\$ 8.92
Costs Mining & Milling				4.00
				<u>\$ 4.92</u>

40,000 tons x 4.92 = \$ 197,000.

Royalty	©	\$1.50		<u>60,000.</u>
				\$137,000.