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DOLLY VARDEN MINES LIMITED

REPORT

by

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Consulting Mining Geologist

January 10th, 1963.

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January 10th, 1963.

DOLLY VARDEN MINES LIMITED
UPPER KITSAULT VALLEY, B. C.

INTRODUCTION

At the request of Dr. F. C. Buckland, President of Dolly Varden Mines Ltd. I have compiled this report from my:

1. earlier ones dated 1st April, 1961, 31st January, and 7th May, 1962;
2. recent review of the results of exploration work during 1962;
3. study of some of the records just made available by Torbrit Silver Mines.

I examined the various properties in the field from the 15th to 25th of August, 1961.

SUMMARY

Dolly Varden Mines Ltd. now has about 250,000 tons of proved and probable ore reserves with excellent chances of increasing this amount substantially by carrying out an exploration programme during this year.

For \$200,000 the company has acquired all the assets that belonged to Torbrit Silver Mines in the Kitsault valley. Another \$175,000 has been spent and \$100,000 more will be required to place these assets in full operating order.

To prepare the North Star ore-bodies for production sufficient to maintain the mill at 400 tons per day will require \$160,000.

Other items of recommended expenditure for this year are \$120,000 for access roads and equipment, \$90,000 for exploration at the Wolf and Dolly Varden, and \$40,000 for overhead and contingencies.

It is expected that a working profit of \$60,000 per month will be achieved when the mill starts operating in September.

GENERAL

The price of silver has now reached \$1.30 per ounce in Canadian money as compared with 85 cents when the Torbrit mine was working. At the higher price this mine would have realized an additional profit of seven million dollars during the nine years that it operated or an average of \$6.50 per ton extra.

Dolly Varden Mines now has completed the purchase of all the assets of Torbrit Silver Mines in the Kitsault Valley including the Torbrit and North Star mines, the mill, hydro-electric power plant, township, various equipment, etc. for \$200,000.

During the past year \$175,000 was spent on rehabilitating these various items. Another \$100,000 will be required for further mill repairs and a new crushing plant.

The company now owns four mines; namely, Torbrit, Dolly Varden, North Star, and Wolf of which the last three are described in the following pages.

D O L L Y V A R D E N M I N E

TOPOGRAPHY

The main workings are situated on the precipitous west side of the valley of the Kitsault River (elevation 900 feet). The lowest tunnel is at elevation 1410 and the highest at 1781 feet whilst a series of open-cuts trace the vein still further up the steep slope to the 2150 foot elevation where the overall slope becomes much less with the highest point on the vein at about 2200 feet elevation.

A number of gullies that drain northerly form marked features in this area.

GENERAL GEOLOGY

An excellent account with a map of the Geology of the Upper Kitsault Valley by J. M. Black appears in the Minister of Mines Report for 1951.

The Dolly Varden deposit is directly astride the projection of the axis of an elongated intrusion of porphyry that stretches for five miles in a south-southeast direction. The vein is 4000 feet south of the intrusion with the Torbrit and North Star veins half way between at the 1000 foot elevation.

Numerous faults provide a structural setting to the ore deposits. Thus Black shows a strong fault along Evindsen Creek that strikes north-northeast and another parallel one at 5600 feet to the west. It is quite likely that a third parallel fault is present at 5600 feet to the east of Evindsen Creek defined by Barite Creek and the segment of the Kitsault Valley immediately in line to the south. This fault direction is also found in the Dolly Varden Mine. It is also the direction of elongation of the small intrusion between Tiger and Musket Creeks. Curiously enough the axis of this intrusion when extended to the southwest passes through the Torbrit ore-body, the old North Star workings and just west of the developed section of the Dolly Varden.

The known silver deposits of the Kitsault Valley are confined to a narrow belt 2000 feet wide that strikes north for 4 miles from the Dolly Varden Mine. This also is a fault direction in the mine and by inference elsewhere.

LOCAL GEOLOGY

The accompanying map of the surface exposures at the Dolly Varden shows a westerly striking vein that dips from 40° to 60° north and is cut up into numerous segments by a series of northerly, northwesterly and northeasterly striking faults that usually dip from 30° to 60° west. This combination produces a flat rake to the individual segments of the vein. The horizontal fault movement may be as much as 140 feet so that it proved difficult to follow the vein underground.

The old maps are quite valuable especially as the upper workings are now inaccessible.

The mapping of J. T. Mandy (1936) shows that in the known ore-bearing section of the vein the hangingwall rock is volcanic breccia and the footwall is andesitic lava for a vertical range of about 375 feet. Higher up the hillside both walls consist of andesite and although the vein is quite strong and well mineralized at least with pyrite it is reported to be barren. On the bottom level (1410) only breccia is seen on both walls of the vein which is poorly mineralized and almost barren of silver.

Thus the vein appears to occupy a reversed fault that has displaced a southerly dipping contact between andesite and the underlying breccia.

MINERALIZATION

In the "glory holes" the exposed vein is seen to contain about 30% pyrite with occasional patches of galena. The high grade material that was shipped originally was reported to consist mainly of galena with subsidiary tetrahedrite, argentite, native silver and ruby silver. Underground sphalerite and chalcopyrite are also present.

Previous observers have decided that the native silver in the very high grade ore was of secondary origin. However, the sulphides are usually completely fresh and unoxidized within a few inches to a few feet of the surface due to the recent age of the glaciation in this valley so that it is unlikely that surface enrichment is responsible for the high grade. It is more likely that local structural conditions have caused a concentration of primary silver mineralization and that additional surface enrichment is due to the subtraction of pyrite by oxidation.

Mr. J. Maclean of Alice Arm states that he was a miner in the early days working in the cross-cut that exposed high grade silver ore in massive galena.

ORE DEPOSITS

The known ore appears to be localized in the vein near cross faults that are known underground as the 403, 304, 417 and 206 that all dip to the west.

Between the 1640 and 1410 levels the ore has a lower limit that probably coincides with the contact of the breccia and the andesite where it leaves the plane of the vein on the footwall side. A downhole from the inner end of the 1640 level showed that the ore extended at least 90 feet below the level and against the 206 fault.

A fan of holes from the end of the main cross-cut on the 1640 level failed to find the next segment of the vein although it is known on the surface. It is

quite possible that the drilling missed the vein because of the faulting.

When seen in a composite plan the known ore occupies an area 550 feet long and up to 200 feet wide with a vertical range of 375 feet. At present it is limited at the western or inner end of the mine by the 206 fault. As it appears likely that the ore is following the part of the vein that has dissimilar rocks on each wall it should be present at this horizon beyond the 206 fault.

ORE RESERVES

In the following estimates the assay values shown on the old company's plans are accepted but until new workings have penetrated the main blocks of new ore below the 1640 level there can be no certainty of the grade which at present is based on the assays on the level and a few diamond drill holes.

As much as 11,000 tons of probable ore averaging 25.0 oz. Ag per ton is shown in the old stoping areas above the 1640 level on the old ore-reserve section whilst another 36,000 tons at 20.0 oz. Ag of probable ore could well be present as indicated between the 1410 and 1640 levels. Thus a total of 47,000 tons averaging 22.0 oz. per ton is probable available in the present mine.

SURFACE EXPLORATION IN 1961

The detailed mapping to a scale of 1 inch to 40 feet of Dr. J. T. Mandy was extended in 1961 to show the vein outcrops and cross faults for another 1200 feet to the west.

A most promising section was found between coordinates 1280 and 1440 west. Here there is a bluff of vein material about 50 feet high near the west end where there is a pronounced north striking valley that no doubt follows a fault zone. There is also a large quartz outcrop at the east end of this section plus subsidiary outcrops of what must be faulted segments as shown on the map.

A self-potential survey over this area showed that the main segment contained considerable sulphides since it recorded a large area with a potential difference of 250 millivolts above background.

An old cut (now No. 16) at the foot of the bluff was deepened and extended to expose a horizontal width of 45 feet of fresh vein material. It was found to contain from 2 to 5% pyrite, 1 to 2% sphalerite, up to 0.5% chalcopryrite and up to 2% of galena plus tetrahedrite in a gangue of mostly calcite with subsidiary quartz and a little barytes. The walls are not well-defined but the dip appears to be from 45° to 60°N.

This exposure was sampled in 5 feet sections, as shown on the plan, giving an average of only 0.30 oz. Ag per ton with the best section still only 0.80 oz. Ag per ton.

Another cut (No. 15) was made through the shallow overburden at the middle of the self-potential anomaly. Similar mineralization was encountered for a width of at least 39 feet after passing through masses of porous limonite, and black manganese wad that both contained malachite and azurite in places. In the fresh material more barytes was recognized than in cut No. 16.

The footwall had not been reached and some sections were still partly oxidized when the samples shown on the plan were taken. They give an average of only 0.21 oz. per ton, the best being 0.95 oz. Ag over 3 feet where a seam of galena and chalcopryrite was cut obliquely.

UNDERGROUND EXPLORATION

The upper levels (1780 and 1716) are inaccessible due to caving from the glory holes.

In 1961 the 1640 level was drained of water that had been dammed back by a fall of ground for many years. From six to eighteen inches of red mud is now left on the floor and should be sluiced out if possible using the water from the diamond drill holes at the face of the main heading.

As far as could be judged from the dirty state of the walls the old mapping of the mineralization, faults and dykes was correctly done.

The 1410 level consists of a 9 foot by 8 foot heading, 1000 feet long, that was to be the main haulage. It is all in purple and green volcanic breccia.

A piece of the Dolly Varden vein was encountered at 600 feet for 25 feet situated between two fault segments of the main northeast dyke known on the levels above. The old sampling here shows a value of 5.6 oz. Ag over 5 feet on the north wall; the balance assays 0.4 oz. Ag for 20 feet. The south wall averages 0.5 oz. over 35 feet.

Drilling from two set-ups to the southeast at 850 feet and the face picked up the vein again. A cross-cut at the 850 foot position exposed the vein 20 feet wide and dipping 55° north with some pyrite in the hanging and footwall sections. Chalcopyrite was also seen in the hangingwall and a few small streaks with fine galena were also recognized. The old sampling of the westwall gave an average of 2.5 oz. Ag over 30 feet whilst a streak of galena on the south side near the face gave 128 oz. Ag per ton. J. M. Black sampled the same 30 feet in 1951 and obtained an average of 0.70 oz. Ag per ton with 0.3% Pb and 4.0% Zn.

Another cross-cut at the 920 foot position only reached the hangingwall of the vein.

There is little doubt from the position and appearance of this vein that it is the Dolly Varden structure; unfortunately it is not ore. Down holes from the 1640 level show that ore values are present 130 feet above this section.

The face of the heading appears to have stopped at the 206 fault. Two holes 150 feet long were fanned ahead in an unsuccessful attempt to locate the vein again. The correct procedure was to have driven a few feet beyond the fault and then drilled parallel to it on its west side to find the next segment of the vein.

Three holes were recently drilled from the surface near the No. 2 Glory hole of the old Dolly Varden mine.

No. 200 passed through the 206 ore-body just above the 1780 level giving 39 feet averaging 26.6 oz. Ag per ton.

No. 201 cut the 252 ore at 20 feet above the 1780 level giving 6 feet of 19.1 oz. Ag.

No. 203 gave 10 feet of low grade just below the 304 fault at 15 feet below the 1640 level.

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These results confirm the good grade of ore shown in the old records.

It has been suggested that a substantial tonnage of ore could be obtained by the surface mining of the old glory hole areas of the Dolly Varden. This could be possible around Nos. 1 and 2 glory holes between elevations 1780 and 1900 feet in an area approximately 200 by 200 feet. Much of the ore here has already been mined both from the glory holes and from underground stopes. A series of vertical holes would be necessary to determine the tonnage and grade that might be available. An unknown amount of low grade but profitable ore is probably present in the dumps at the portals of the 1780 and 1638 levels. These would require deep trenching and sampling.

All rejects from the assaying of samples should be saved for mill tests.

FUTURE EXPLORATION

An exploration programme must be based on a correct appraisal of the significant features in the geological settings of the known deposits in an area. Thus in the Upper Kitsault Valley the following factors appear to be significant in the locations of the silver deposits:

1. The occurrences are confined to a belt striking N 8°W that is 4 miles long and 2000 feet wide with the jamor deposits at the south end.
2. Strong fracturing in a northerly direction although the ore-bodies may strike in any direction.
3. There is a limited vertical range to the individual ore-bodies due possibly to wall rock, tension conditions and temperature at the time of mineralization. Thus:
 - The known ore at Torbrit was between 800 and 1200' el. and an upper body could have been eroded away.
 - The ore at the North Star is between 1000 and 1300' and also 1500' and 1700'.
 - At the Dolly Varden between 1500' and 1850'.
 - At the Wolf between 1200' and 1650'.
4. The presence of small intrusions of feldspar porphyry.
5. Major north-northeast faults.

These factors suggest that there is an excellent geological possibility of a major ore deposit on the Dolly Varden structure between the 800 and 1300 foot elevations. This possibility can best be tested by diamond drilling from the end

of the 1000 level in the North Star workings.

There is also a good chance of further ore to the west on the Dolly Varden structure between the 1500 and 1850 foot elevations especially down the dip and rake of the wide section of the vein that was explored on the surface in 1961. This area could be tested by vertical diamond drill holes from 300 to 500 feet deep.

N O R T H S T A R M I N E

This property was extensively drilled by Torbrit Silver Mines but the results have only recently become available.

In 1961 an examination was made of each of the four adits that range in elevation from 1660 down to 1017 feet.

The main exploration was the driving of the 1000 adit by Torbrit Silver Mines a few years ago which resulted in the discovery of an ore-body at 800 to 1100 feet along the vein from the portal. This ore is not exposed but was proved by a series of diamond drill up holes from a 200 foot long cross-cut in the footwall. The vein strikes N 30°E and dips 45°N.W. It is cut up into segments by numerous faults that strike northwesterly.

There is also a set of three workings at much higher elevations that are almost certainly on the same vein. Because of the dirt and iron staining it was difficult to assess the true mineral content of the vein in these workings.

The topmost one consists of a 40 foot adit at elevation 1660 feet where a 20 foot vein is exposed containing about 20% pyrite and some galena. A few tons of sorted material on the dump contains considerable galena and presumably is of good grade.

At elevation 1560 feet a tunnel 200 feet long exposes a similar vein and J. M. Black reported a sample over 7 feet from it that assayed 36.7 oz. Ag. The distribution of the mineralization suggests that such values could exist for 140 feet along the adit.

At elevation 1490 feet an irregular tunnel was driven for 320 feet with some cross-cuts. It follows the vein in part but also the more easily drilled dykes.

The full width of the vein is only exposed by the cross-cutting at the inner end. Copper stains are frequent and when investigated were found to be associated with chalcopyrite. A fragment of rich galena-sphalerite ore was picked up at the portal but was not seen in place. No assay plan is available for this level and there is no evidence of systematic sampling.

An attempt was made to follow the outcrop from the 1660 adit to the south. At about 200 feet, probably just inside the Dolly Varden No. 1 claim, an outcrop of iron-stained quartz was found at the side of a pronounced gully and just west of an old cabin. The gully was followed to the portal of the 1780 level of the Dolly Varden mine and it therefore corresponds to the 304 fault. Some quartz was found in a few places on the east side of the gully.

ORE RESERVES

A geological plan of the 1000 level, cross sections of the ore-body and the complete log of all the drill holes into the North Star zone are now available.

The increase in the price of silver allows a greater thickness to be taken in many places in calculating the amount of ore present. I find that there are 125,000 tons averaging 12.5 oz. Ag per ton with an average width of 20 feet.

The 23 drill holes indicate that the thickness ranges from 10 to 38 feet and the grade from 7.4 to 31 oz. Ag per ton. The lead assays that are available from 11 holes average 1.0% Pb.

PROPOSED MINING

Before this ore-body is put into production an efficient ventilation system will be required which will involve an upper level approximately 600 feet long on the vein at the 1300 foot elevation. It will provide excellent exploration as well and could be used to indicate another block of ore above it.

An effective stoping method must be planned that takes into account the dip of 45° and mining to an "assay wall". A tentative scheme is a centrally placed ore-pass at 60° in the footwall opposite a central pillar that is 50 feet along the

strike and continuous up the dip of the vein. On either side of this there would be stoping areas 100 feet long with combined manways and ventilation raises at the far ends. A service raise at 45° would be placed in the central pillar from which sublevels would be driven at 45 feet vertical intervals. Alternate sublevels would be used as scraper drifts feeding into the main ore-pass or a branch of it.

The sublevels would be slashed out to the full width of the ore that would be determined by the original drilling plus test-holing.

Parallel blast holes 25 feet long would be drilled up and down dip on parallel sections from the sublevels and retreating from the ends to the central pillar. This should give excellent fragmentation and therefore a minimum of secondary blasting.

A 25 foot pillar would be left beneath each scraper drift and recovered in sequence from the top to the bottom of the ore-body. The central pillar would be recovered by retreating up the service raise.

The access from the Torbrit Mine, a bridge over the Kitsault River and slashing out of the 1000 foot adit will take two months and cost about \$25,000.

It will require about \$75,000 to do sufficient of the stope preparation to get into a production of 300 tons per day for a five day week in the mine equivalent to 200 tons per day for a seven day week in the mill. Another \$75,000 will eventually be spent in preparing the balance of the ore-body for extraction or a total of \$1.70 per ton. Drilling, blasting and slushing will not cost more than \$1.50 per ton and haulage to the mill is estimated at 80¢ per ton. Thus the total mining cost should be about \$4.00 per ton.

With milling at \$3.00 per ton and development at \$1.00 per ton the total direct costs would be \$8.00 per ton. The cut-off grade would therefore be 6 oz. Ag and 1% Pb. The average grade of 12.5 oz Ag, 1% Pb. should give a working profit of \$7.50 per ton.

If the new adit at the 1300 elevation is started at the same time as the raises it should be possible to have the first block of ore ready for stoping within three months especially if a raise climber is used to speed up the work.

Owing to the extreme steepness of the mountainside it will be difficult to gain access to the site for a portal at the 1300 elevation. It should be possible however to cut a trail with ladderways from the 1000 portal obliquely up the mountainside for foot travel and to install a high-line directly across the river to transport supplies to the adit.

The air and water lines (aluminum) would follow the trail although water may be available near the site.

The alternative is to drive a special service raise costing \$15,000 from the 1000 level that would hole through to the surface at the 1300 elevation and then drive the tunnel. Once the raises in the ore area have connected with the 1300 level this special service raise would have little use.

POSSIBLE SECOND ORE-BODY

The main 1000 adit of the North Star passed through an area with silver values for 250 feet before reaching the area of the main ore-body. These two areas are separated by an assumed fault that has an offset of at least 100 feet.

The values were obtained in the adit itself as well as in drill holes in a series of five fault segments; for a total distance of 260 feet they average 11.8 oz. over 15 feet. This is more encouraging than the average of the values obtained in the flat holes into the main ore-body.

It is proposed to drill a series of 8 up holes totalling 2200 feet from the end of the southeast cross-cut on the 1000 level to explore this portion of the vein up dip as far as the 1300 elevation. This drilling could indicate the presence of 50,000 tons or more of ore. The details of the holes are as follows:

- | | | | |
|----|---------------------|------|--------------|
| 1. | At N 15° E inclined | 20° | for 200 feet |
| 2. | N 22½ E | " 15 | " 250 " |
| 3. | N 45 E | " 50 | " 200 " |
| 4. | N 45 E | " 35 | " 250 " |
| 5. | N 65 E | " 45 | " 300 " |
| 6. | N 70 E | " 55 | " 250 " |
| 7. | N 90 E | " 63 | " 260 " |
| 8. | N 90 E | " 50 | " 300 " |

W O L F M I N E

An examination of the surface showings and a study of the diamond drilling results form the basis of the following account. A number of old plans are available showing the open-cuts and diamond drilling with the assay results. The only inaccuracy noted is the contouring along No. 1 vein which does not show the steep gully along the south edge of the outcrop nor the similar gully running northeast from the site of the holes drilled in 1960.

There are three parallel veins striking N 15°E to N 30°E and dipping steeply west that are here designated Nos. 1 to 3 in order from east to west. It is possible that all three are segments of one original structure now divided up by faults striking due north.

No. 1 Vein

The topography here is extremely steep so that there has been some confusion over the true strike and dip of the vein. Thus diamond drilling in 1960 was set out for a strike of about N 60° E and a dip of 50 - 55°W. It was thought that drill results indicated a still flatter dip. Actually the vein strikes N 30°E and dips 70°W as can be found by construction using the original diamond drilling results.

All the information to date has been plotted on the accompanying vertical projection using this strike and dip and calculating the equivalent horizontal width for each drill intersection and open-cut exposure.

The discrepancy between the surface sampling and the values in the tunnel or diamond drilling suggests that enrichment at least by leaching out of sulphides has taken place in the first few feet below the surface. Thus in the trench at elevation 1766 feet where the old sampling gave 12 feet averaging 10 oz. Ag per ton recent sampling after blasting down to fresh unoxidized sulphides gave 14 feet averaging 3.6 oz. Ag per ton.

It is interesting to note however that high grade streaks can be traced

by the assays from the tunnel through the nearer drill holes and that therefore high values obtained by drilling should not necessarily be reduced as being purely local erratic highs. It is guessed that No. 4 hole drilled in 1960 is not located where reported and that the high value of 110 oz. Ag per ton corresponds to one of the high grade streaks.

As indicated on the vertical projection an estimate has been made of 20,000 tons of proven ore averaging 16 oz. per ton and 35,000 tons of probable ore averaging 12 oz. Ag per ton for the No. 1 vein.

The proven ore is based on a continuous outcrop, an 80 foot tunnel and 7 diamond drill holes. The bulk of the probable ore is based on a continuous but largely inaccessible outcrop and only five diamond drill holes that are poorly spaced.

A fault striking northwest and dipping 60° northeast probably displaces the vein outcrop at elevation 1690 feet about 30 feet horizontally to the southeast and would also account for the anomalous relative positions of some of the diamond drill intersections.

The absence of the vein in No. 28 hole indicates that No. 1 vein does not extend much further south of the tunnel. A steep fault striking due north to the upper end of No. 2 vein could have displaced an original single vein.

No. 2 Vein

This vein which is 270 feet west of No. 1 vein has a northerly section that is well exposed over a length of 300 feet and a width of 20 feet between the 1500 and 1700 foot elevations. It has been explored with 8 open cuts and 12 diamond drill holes as shown on the accompanying projection.

Most of the holes are clustered around the south end of this section where 5000 tons of ore averaging 13 oz. Ag per ton can be estimated.

There are no outcrops for the next 300 feet to the south and it has not been tested by diamond drilling but it is interesting to note that the best drill intersection of the previous section is at the beginning of this one.

In 1962 a series of holes, numbered 50 to 54 were first drilled obliquely to the strike at the south end of No. 2 vein with indifferent results. A footwall vein is present here that splits from the main vein at 150 feet to the north.

Next holes 57, 58, and 59 were drilled on a section through the junction of these veins with an average value of 14.7 oz. Ag over a true width of 12 feet for a vertical range of 70 feet.

Hole 60 at 50 feet further north gave 12.2 oz. Ag over 19 feet, 90 feet below the old trench that assayed 16.7 oz. Ag over 19 feet.

At another 50 feet the old holes 24 and 25 averaged 11.0 oz. Ag over 6 feet beneath a trench that gave 6.9 oz. Ag over 6 feet giving a vertical range of 80 feet.

At 35 feet north of this section hole 27 gave 11.1 oz. Ag over 6 feet.

These holes show that for an average depth of 80 feet and a length of 160 feet the No. 2 vein contains 13,000 tons averaging 13.7 oz. Ag. A second split vein immediately in the footwall of this ore was intersected by four drill holes that indicate 2000 tons averaging 10.0 oz. Ag.

The encouraging results obtained on the No. 2 vein warrant a programme of underground development. An adit is therefore proposed at elevation 1250 feet. Favourable drilling results in the 300 foot gap mentioned above would warrant a second adit at 1450 feet.

No. 3 Vein

This vein is exposed for 150 feet between elevations 1370 and 1460 feet. It is 130 feet west of No. 2 vein and is from 15 to 20 feet wide. There are 5 open cuts in which the only significant value was 48.8 oz. Ag per ton over 5 feet at elevation 1476 feet. The North end of the vein could be cut off by a fault that also terminates the south end of No. 2 vein.

ORE RESERVES

The ore reserves at the Wolf Mine are as follows:-

No. 1 Vein	Proven	20,000 tons	@ 16.0 oz. Ag per ton
No. 1 Vein	Probable	35,000 tons	@ 12.0 oz. Ag per ton
No. 2 Vein	Probable	18,000 tons	@ 13.5 oz. Ag per ton
No. 2 Split	Probable	<u>2,000</u> tons	@ 10.0 oz. Ag per ton
Total -		75,000 tons	@ 13.4 oz. Ag per ton

Open pit mining has been proposed for most of this ore but if exploration shows that it has considerable extensions at depth, then underground mining may be best.

OPEN PIT MINING

To obtain the low costs associated with open pit mining it is necessary to have a large ore-body so that large equipment can be employed.

Where the snowfall is heavy it not only halts the movement of trucks but the snow in the ore clogs up the crushing plant. This condition prevented Empire Development from operating their open pit iron mine from January to May each year.

The tonnage available for open pit mining at the Wolf Mine is relatively small and any substantial increase in the ore reserve due to exploration will consist largely of ore that would be mined from underground.

The steepness of No. 1 vein and the steep topography are better suited to an underground mine in which all the ore gravitates via one ore-pass to the bottom where direct loading into trucks could be arranged. Long hole, open stopes would appear feasible.

At the Dolly Varden the faulting of the ore into numerous segments and the flat dip make open pit mining more attractive. It will still be necessary to outline the ore quite closely with a regular pattern of holes to determine that enough ore is present however.

STOCK PILING

It has been proposed to open pit mine at the Wolf and Dolly Varden during the summer and stock pile the ore for milling in the winter.

The heavy snowfall on occasions could render the ore too sticky for crushing whilst partial melting and freezing would make the ore difficult to handle without blasting. The pile must be sufficiently far from the mill and other buildings to avoid damage from blasting.

MILL

In his detailed examination of the condition of the mill, Mr. Bapty found that after spending \$16,000 on repairs another \$37,000 would be required to place it in operating order. In addition \$48,000 will be needed to buy and erect a new crushing plant.

Originally there was only a cyanide circuit based on the experience of mining near surface ores with native silver and oxidation products. As the mine deepened it was found that a flotation circuit was needed so that eventually 70% of the silver content was extracted by the flotation unit and only 15% by the cyanidation of the flotation tailing. The balance of 15% was lost in the tailing which averaged 2.0 oz. Ag per ton.

Since there will be three major sources of ore it will be important to carry out mill tests on representative samples of each. Thus it is probable that the North Star ore will respond satisfactorily to flotation only but the semi-oxidized, near surface ore at the Dolly Varden may well require both flotation and cyanidation. The apparently massive nature of the Wolf ore may limit oxidation to only a few feet from the surface so that flotation only could be sufficient.

In each case the sample for mill tests must be representative of a particular type of ore whose extent is known.

Now that a growing market exists for both argentiferous lead and for zinc concentrates the mill testing should specifically investigate these products. The reported high cadmium content of the sphalerite may enhance the value of the zinc concentrates.

DISCUSSION

The following factors must be considered in the immediate programme of work at the mine:

1. Weather conditions will make surface work difficult and expensive for the first four months of the year.
2. Mill repairs can go ahead however in this period.
3. If the crusher house is relocated there will be a problem in pouring the concrete foundations during the winter.
4. If it is found by diamond drilling that a substantial second ore-body exists immediately east of the known North Star ore-body then the two ore-bodies together could supply all the ore needed by the mill for at least 1½ years. Development could then proceed at the Wolf and Dolly Varden without producing from them this year.
5. If an immediate start is made on the preparatory access work to the North Star it should be possible to put the mill into production about September, 1963.

CASH REQUIREMENTS

During 1963 the following items of expense will require financing so that the mine can be in production by the fall:

1. Further repair of the mill	\$ 40,000
2. Crushing Plant	50,000
3. North Star - development of main ore-body	100,000
4. Drilling possible 2nd North Star ore-body	10,000
5. Development possible 2nd North Star ore-body	50,000
6. Access road to Wolf	50,000
7. Exploration drilling at Wolf	20,000
8. Adit at Wolf	20,000
9. Finish access road to Dolly Varden	10,000
10. Testing open pit area - Dolly Varden	10,000
11. Diamond drilling west extension Dolly Varden	25,000
12. Diamond drilling underground lower horizon - D. V.	15,000
13. Equipment for road building and open pits	60,000
14. Overhead, contingencies	<u>40,000</u>
Total -	\$500,000

Of this total only \$300,000 would be required to go into production based on the North Star only. The balance could be financed out of production but since it would be largely for outside work it would be 15 months from now before much could be done. This would leave too little time in which to prepare any new ore-bodies for production.

It is understood that a suitable amount of working capital, say \$300,000 would be loaned by a bank.

OPERATING PROFIT

With the North Star as the only source of ore the costs per ton are estimated as follows:

Mining and hauling to mill -	\$ 4.00
Milling	3.00
Development	1.00
Camp maintenance, etc.	1.00
Overhead	<u>1.00</u>
Total cost per ton -	\$10.00
Average net value of ore -	15.50
Net working profit per ton -	5.50

Thus at 400 tons per day a working profit of \$800,000 per year could be realized.

When the higher grade Dolly Varden ore is milled it will yield twice the profit per ton from 22 oz. Ag ore as compared with 12½ oz. Ag ore from the North Star.

SCHEDULE OF DEVELOPMENT

1. Connection from Torbrit main haulage to river bank opposite 1000 portal of North Star.
2. Simple bridge across river.
3. During items 1 and 2 drill the 2000 feet of up holes into the possible new ore-body immediately east of known ore.

4. Slash out tunnel to 8 by 9 feet to take large cars. Also ditch, heavy track, 6" pipe, 2" water line and ventilation tubing.
5. When tunnel is ready start raises in the two ore-bodies that will become service and ventilation raises connecting with 1300 level.
6. As soon as the weather permits locate and build a foot-trail to the portal site of a 1300 level. Install air and water lines. Erect a "high line" to the portal site to service the tunnel from across the river.
7. Drive the 1300 adit along the footwall side of the vein for 500 feet in time to meet the raises from below.
8. Drive scraper and drilling drifts - then slash out to full width of ore.

EXPLORATION PROGRAMME

In addition to the drilling into the possible second ore-body of the North Star the following exploration is recommended for 1963:

1. On the surface drill a series of vertical holes from 300 to 500 feet deep to trace the supposed productive horizon of the Dolly Varden vein west from the present mine at approximate locations 1000 W, 1120 W, 1280 W and 1440 W for a total of 4000 feet.
2. From the end of the southwest heading on the 1000 level of the North Star drill flat holes for about 500 feet due south, S 15°W, S 35°W and S 50°W to explore for a second productive zone in the Dolly Varden vein for a total of 2000 feet.
3. From the end of the southeast heading on the 1000 level of the North Star drill flat holes for 600 feet to S 15°W, due south and S 15°E to further test for the Dolly Varden vein - say 2000 feet.
4. Drive an adit at 1250 feet elevation on the Wolf No. 2 vein.
5. At the Wolf property plan two drill set-ups on the west side of No. 2 vein so as to explore the central covered section that is 300 feet long with a total drilling of say 2000 feet.
Also, set up at 1550 elevation to further test No. 1 vein with say 1000 feet of drilling.
6. Follow up favourable drilling results with underground development.

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