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OUTLINE REPORT ON LUCKY JIM MINE

5 prints to accompany this

No. 11.

L50-117.

The Lucky Jim property is owned and operated by Sheep Creek Gold Mines, Limited. It was acquired in 1941 from Victoria Syndicate for a reported purchase price in the neighborhood of $60,000. and a subsidiary company, Zincton Mines, Ltd., was set up to operate. In the summer of 1943, apparently, the property was operated by Sheep Creek, and Zincton Mines bought and explored the old Parridice near Windermere.

The property is on the south side of Seaton Creek, 1/2 mile west of the divide with Kaslo Creek. It is on both road and railway, 13 miles from New Denver and 21 miles from Kaslo. The portal of the lowest, adit level is at an elevation of approximately 3,565 feet.

Zinc concentrates were sold during 1942 to the Anaconda Smelter at Butte, Montana. Late in 1942 a contract was made with Metals Reserve Corporation that provided a better price by, in effect, waiving the tariff of 1.2¢ per pound of zinc. Under the present contract a price of about 3.7¢ per pound, U.S. funds, is paid for 100 per cent of contained zinc in the concentrates, f.o.b. Zincton. The Company agrees to spend a stipulated amount annually on development work with a view to developing new ore-bodies; part of this money was spent, during the late summer of 1943, at the Parridice.

The capacity of the old Lucky Jim Mill was raised from 200 to 300 tons per day early in 1942 but, owing to the labor shortage, capacity operation was not attained for long, and during the latter part of 1943 only about 200 tons per day was milled. In

November, 1943, the old, worn out flotation cells were replaced by new, Denver cells and it was expected that this might slightly increase recovery and grade of concentrate.

Heads average about 10% zinc. Recovery is about 85 per cent, producing concentrates containing about 57% zinc, 1½ oz. silver, 0.3% cadmium, and a small amount of lead. Operating costs in 1942-3 amounted to $3.25 per ton, made up of $1.75 for mining and development and $1.50 for milling and overhead.

Between 60 and 70 men were employed during 1943, but efficiency of work was low and absenteeism was high. Of an underground shift of 18 men it was not uncommon for as many as 6 or 8 to absent themselves. A bonus was paid on the basis of total footage drilled per day in the stopes, and bonuses were rather freely paid on development work. As a consequence, mining costs were higher than they would be in normal times.

Up to date only such development work has been done as is absolutely necessary. The property was acquired with ore in excess of 150,000 tons proved up, and which necessitated very little work in addition to that of direct mining. About 15,000 feet of diamond drilling has been done, several service and transfer raises have been driven, and one short sublevel (850) has been put in. All this in the block of ground previously explored. This indicates only that the Company has been fortunate in the matter of development, but it may possibly be that development costs per ton of ore mined over a long period of life in the mine, in new ground, would not be much in excess of those experienced during the last two years.

Certainly it can be said of the present operation that more development could have been done and at least part of the expense been offset by cheaper mining costs embodied in the laying out and servicing of stopes.

The Company does no geological mapping and prepares no sections. It is true that there are two geological maps, drawn in extreme detail, prepared prior to 1930 and to which reference is frequently made, but the workings driven since that time have not been mapped. Also, the early mapping recognized only one concept in ore-deposition, namely that of cross-fracturing, and that concept is no longer of much importance - consequently these maps could well be redrawn, not only to be brought up to date, but to show to best advantage the factors which are now known to be of chief importance in the localization of ore-bodies. It is my opinion that proper geological study of the mine would more than pay for itself in reducing the cost of development and improving over all stoping practice.

The writer finds it impossible to state what mining costs could be obtained, but the foregoing matters have been dealt with at some length in order to indicate the general problems involved. Present overall operating costs of $3.25 obtain under conditions of unavoidable expense and inefficiency and it is safe to say that in more normal times the output per man will increase, at a lower wage cost. Development charges per ton of ore, over a long period, might be higher, but on the whole and provided adequate geological study is made, the net effect will be to lower operating costs.

Mining Methods

Mining is by open stoping. The ground is strong enough to support large openings, with unsupported hanging wall areas as much as 60 or 70 feet across and of greater length along the dip, and there is no timber in the mine except in chutes and manways. The ore-bodies are irregular and pillars are haphazard, being waste for the most part. Some sections are steep enough for the muck to run but some sections have a low dip so that scraping, perhaps in stages, has to be employed.

When an ore body is indicated, either from exploratory drifting alone or from prior diamond-drilling, stoping is started directly. One or more raises are put up into the ore-body and are enlarged as soon as a safe distance from the level is reached. As it is seldom known where the limits of the body are, slashing is carried forward until waste is encountered. Little system is employed in early stages, and even when the stope is well advanced little over-all system is attempted such as requires preparation over more than a few days. Drilling is from bar or tripod. Muck is kept clear, with very little remaining in the stope at any time. Service raises or connections are put in only as and if found to be necessary. If the stope faces all become lean or barren diamond-drilling is resorted to to determine if and where further ore lies ahead.

Exploration

Preliminary exploration is by diamond-drilling. A general rake to the ore-bodies is apparent, but they are irregular in outline and may include areas of low-grade or waste. Drilling is consequently no more than indicative, but any intersection of say 3 or more feet of mineable grade is followed up, and experience has shown that it is rarely that small isolated bands or patches of strong mineralization occur at any distance from a workable ore-body. Prior work indicated and in part proved several ore zones, and one totally new zone has been picked up by drilling. Work has largely been limited to tracing and delimiting these zones, but a little completely exploratory drilling has been done.

Too little has been known of the controls of ore-deposition to lay out work to maximum advantage. Much drilling has been done along the limestone body - following dip or strike - rather than at right angles to it, necessarily so because the distribution of workings has not always favoured cross-cutting holes.

When it appears likely that an ore-body exists in a certain section an exploratory drift or other working is driven to that section and perhaps additional drilling is done. Stoping is started in an exploratory manner and may continue to be exploratory for several months.

<u>Geology</u>

The ore-bodies all lie within a band of limestone which is a member of the argillaceous Slocan series. The average strike is about N 40° west and the dip is about 45°, with many variations. Many "porphyry" dikes occur, to give them their local name (see Cairnes, Mem. 184).

The Slocan series is here composed of slaty argillites and a few quartzitic and calcareous beds. Cleavage is well developed, for the most part parallel to the bedding, and some of the rocks are black, paper-thin slates. A few narrow limestone bands occur in addition to the principal productive band.

The productive limestone is characteristically brecciated, with fragments, including some of slate, from a fraction of an inch to several feet in size. In one stope a slate rib within the breccia was about 30 feet long and 1 to 3 feet wide. The band is not brecciated throughout but, where explored, it is perhaps 75 per cent converted to breccia. The band varies enormously in thickness, from 16 to more than 200 feet in horizontal width in sections of apparently similar dip.

The limestone appears to have been originally about 20 feet or less in thickness. Brecciation has in many places destroyed all evidence of bedding, and mine workings are rare in the argillites (slates, to give them the local name, which is nearly geologically correct) so that details of the deformation are hard to follow. Earlier reports refer to flowage as the dominant manner of failure, but the present writer recognizes evidence of rolling and drag folding that has been important. There has certainly been flowage involved, but there is also clearly recognizable folding that has produced the same effect, and brecciation along axes of tight folds, and along faults could easily mask evidence of some of the folding.

The shape and size of the limestone body is further complicated by faulting. Only two faults were recognized that strike across the limestone and offset it, but there are numerous strike faults, the importance of which it is hard to assess. These latter faults, which more or less follow the bedding, are prominent in the slates, but within the limestone they are relatively insignificant. The workings are not sufficient to disclose all of these faults or to afford positive correlation, but on each of the better developed levels there are several longitudinal faults, and it is believed that the total effect of these has been of extreme importance, both in producing an effect of thickening and thinning in the limestone and probably also in introducing ore-bearing solutions.

The fact of thickening, thinning, and folding in the limestone is stressed, as it is of primary importance both in the localization of ore-bodies and in the conduct of exploration.

The Lucky Jim ore is formed by replacement in limestone. It consists of sphalerite, pyrite, calcite and a very little quartz in a limestone gangue. The relative proportion of pyrite and sphalerite varies considerably, and some mineralization is composed dominantly of pyrite. The ore in any body occurs as pods, lenses, stringers and irregular masses, locally forming a systematic pattern but more often not. The boundaries of an ore body are commonly distinct, with very little gradation from ore, through low-grade material, into barren rock; in other words the boundaries are not assay boundaries. Small, isolated patches of mineralization are rare and a very large proportion of the zinc in the known part of the property is contained in mineable ore bodies.

The ore consists of brown sphalerite in aggregates coarse enough that the grade is readily estimated, at least in grades below 15 per cent. No mine sampling is done except in diamond-drill intersections, but sight estimation of grade is reported to be satisfactorily accurate.

All references to the Lucky Jim Mine refer to the importance of cross-fractures which control the deposition of ore. These fractures, singly or in sets, cross the limestone approximately at right angles, and are either vertical or possess a steep dip to the northwest. They are for the most part narrow cracks that pass through both limestone and slates, and some of them contain small amounts of sphalerite, even in the slates. In some sections these cross-fractures are seen to carry relatively massive sphalerite from 1/4 inch to several inches in width, and locally the mineralization attains widths of several feet. Where a number of mineralized fractures are present a section may constitute ore by virtue of close spacing of narrow bands of sphalerite, or by coalescence between or across fractures.

Cross-fractures, and the effect of them in canalizing mineral-bearing solutions, are most prominent in the upper, older workings, above 5 level. It is certain that they acted as channelways for solutions, as claimed by former workers, but, in addition, the writer recognizes a tendency for the cross-fractures (particularly those that are mineralized) to be localized in or along rolls in the limestone. With depth the cross-fractures become less abundant and less important.

On 9 level the most prominently developed sites of cross-fractures do not coincide in position with the major occurrences of ore, even though they locally contain minor amounts of sphalerite. In this section of the mine no fractures can be positively said to have introduced the mineralization, although there is a suggestion that steep, longitudinal fractures may have been important. Sets or single individuals of random attitude occur but do not appear to be controlling factors. In this section of the mine there is evidence that the ore bodies lie in rolls in the limestone.

In the upper sections of the mine, then, the ore is controlled by cross-fractures which vary in strength individually, but on the whole constitute a discontinuous sheeting. The ore-bodies in this section plunge south-westward down the dip but, because the cross-fracturing tends to be localized on rolls there are local westerly rakes. Below 5 level the cross-fracturing or sheeting is less marked, the ore bodies plunge westward with the regional plunge of the structure, and the control is dominantly one of rolls in the limestone. A further control is distinctly inferred, and while positive proof was found lacking, the writer believes that mineralizing solutions were introduced by longitudinal faults, which are therefore of primary significance.

It has been pointed out that longitudinal faulting occurs and has probably affected the apparent thickness of the limestone. This is most evident on 5 level, where there is a repetition of the limestone in a cross-cut into the footwall: a hypothetical section here indicates a considerable amount of movement on a (thrust) fault. There is some scanty evidence for the belief that the faulting and folding (and by inference the brecciation) were related, and if so the faulting is all thrusting. On 9 level the vertical, longitudinal mineralized fractures referred to are probably related to the faulting, but the difficulty of assessing the strength and importance of a break or fracture in limestone of course makes this point difficult to prove.

The porphyry dykes appear to have had no affect on the introduction of ore. In one stope a dyke appears to have had a local damming effect, but this is only local. The dykes are not mineralized.

An ideal sequence appears to have been: folding and brecciation, thrust faulting longitudinally along the structure, introduction of longitudinal dikes, and introduction of mineralization along longitudinal controls of faulting and folding. Ore bodies formed on rolls in the lower part of the mine, with rakes of 15 to 40 degrees, but in the upper part of the mine solutions were canalized by cross-fractures and ore-bodies formed more along the dip, but still with a tendency to plunge westward.

The problem of exploration is primarily to trace the rolls in the limestone body, rolls that are in many instances of such gradual curvature that they are easily missed. Secondarily, the fractures in the limestone and in the adjacent slates should be studied. The history of development to date has shown how easily ore bodies may be missed, and certain sections on several levels still remain imperfectly explored. It will always be necessary to resort to diamond-drilling, but preliminary, exploratory drifts in new sections should be laid out to pass through areas of known or possible rolls and they should also be so situated as to provide points from which drilling may positively and efficiently test and delimit all additional likely ground on the level.

Ore position and future possibilities

It is impossible to make accurate tonnage estimates. Production records of the present company show that, of about 200,000 tons of ore mined, 80,800 tons came from 1000 stope between 8 and 5 levels, 57,400 tons from 910 stope above 850 level, and 28,400 tons from 920 stope on 9 level. On the basis of these figures, assessing possibilities of extension of known ore-bodies, the chances for production of sections merely indicated by diamond drilling, and less certain possibilities that to date have received no attention whatever, it is possible only to hazard a guess as to what ore remains in the present block of explored ground.

On this basis there probably exists, in mineable bodies, about 200,000 tons of ore from 5 level to 50 feet below 9 level within the confines of present exploration. Exploration at the end of the year was reaching a stage when a far better knowledge of the geology was likely to materialize, but the writer's personal opinion is that the above figure will be exceeded.

For the future, there is indicated a downward continuation of ore below 9 level, particularly beneath 920 ore body. 910 ore body has not definitely been traced yet to 9 level, although known ore there might link up directly to provide continuous stoping ground. All known ore is raking westward, and it is known the structure flattens rapidly below 9 level. The flattening is vaguely seen in 920 stope, and evidence on the surface, to the west, several hundred feet from the mine workings, shows that the average dip is low and that there are flat sections and some reversals in dip, for a distance of at least several hundred feet across the strike.

This flattening has not been explored, and it is not known whether it will prove to be a favorable site for ore bodies or not, but 920 stope appears to lie on the edge of this general structure. If productive on a major scale access would be either from a new adit, followed by a winze, from creek level southwest of the present workings, or else by shaft from some point on the old narrow-gauge railway grade. Diamond-drilling could be initiated from some such latter point, by steep holes, put down several hundred feet west of the present surface holes (these were put in following the dip, a practice that does not tend to furnish positive data). Farther to the northwest the flat bottom of Seaton Creek valley extends for about 1/2 mile, in which there are no outcrops.

Nothing is known to the southeast, along the strike of the limestone body, beyond the faces of existing workings. The faces stop more or less along a line that corresponds roughly to the rake of the ore-bodies. Some diamond-drilling has been done on the surface, southeast of the surface workings, in an entirely new section, but the three holes were put down more or less haphazardly, and have no real significance.

If 920 stope is on a major locus of ore-deposition, as it appears to be, then ore can confidently be expected ahead of the present faces of the upper levels. The flattened section of the limestone climbs slowly to the southeast and, to judge only from Cairne's generalized sections, tends to die out. If the premise of introduction of mineralizing solutions along longitudinal fissures is correct, then continuation of mineable ore to the south-east is a possibility with good chances for success.

Detailed surface mapping has not been done. It is a laborious task, since it should be done, at least along the actual outcroppings of limestone, on the same scale as the mine workings

(40 feet to the inch). Only precise work, with careful attention to elevations, should be attempted.

An attempt should be made to do surface mapping, after and in conjunction with additional underground study. The indicated rolls, which are believed to be important, may not all be recognizable on the surface, but some evidence of faulting and thrusting should be apparent, and some areas if lightly covered might be stripped. Such work, if successful, would pay for itself many times over and might be the only logical approach to a major program of development.

M. S. Hedley
Dec 15, 1943

Accompanying maps —
all 40-scale, with partial geology

1 Surface - west & north-west of workings
2 No. 9 Level
3 Nos. 850 and 8 Levels
4 Levels above No. 8
5 Supplement - part of No. 5 Level.