

Mc82
8c 21m
191
c2

CANADA
DEPARTMENT OF MINES
HON. T. A. CRERAR, MINISTER; CHARLES CAMSELL, DEPUTY MINISTER
BUREAU OF ECONOMIC GEOLOGY
GEOLOGICAL SURVEY

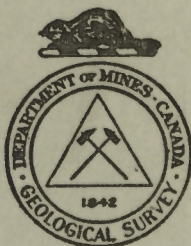
MEMOIR 191

**Lode Gold Deposits of Ymir-Nelson Area,
British Columbia**

BY
W. E. Cockfield

LIBRARY / BIBLIOTHÈQUE

JAN 2 1980



GEOLOGICAL SURVEY
COMMISSION GÉOLOGIQUE

OTTAWA
J. O. PATENAUDE, I.S.O.
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1936

Price, 25 cents

No. 2415

This document was produced
by scanning the original publication.

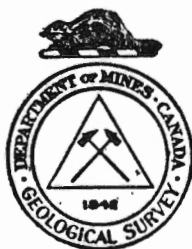
Ce document est le produit d'une
numérisation par balayage
de la publication originale.

CANADA
DEPARTMENT OF MINES
HON. T. A. CRERAR, MINISTER; CHARLES CAMSELL, DEPUTY MINISTER
BUREAU OF ECONOMIC GEOLOGY
GEOLOGICAL SURVEY

MEMOIR 191

**Lode Gold Deposits of Ymir-Nelson Area,
British Columbia**

BY
W. E. Cockfield



OTTAWA
J. O. PATENAUDE, I.S.O.
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1936

Price, 25 cents

No. 2415

CONTENTS

| | PAGE |
|--------------------------------|------|
| Introduction..... | 1 |
| General geology..... | 2 |
| Economic geology..... | 3 |
| Description of properties..... | 7 |
| Index..... | 77 |

Illustrations

| | |
|--|-----------|
| Figure 1. Ymir-Nelson area, Kootenay district, B.C., showing location of properties described..... | 4 |
| 2. Geology of mineral claims, Second Relief mine..... | In pocket |
| 3. Nevada and adjoining claims..... | 13 |
| 4. Centre Star mine..... | 21 |
| 5. Ymir Yankee Girl Gold Mines, Limited..... | 28 |
| 6. Goodenough mine..... | 35 |
| 7. Fern mine..... | 50 |
| 8. Royal Canadian mine..... | 73 |
| 9. Nevada mine..... | 74 |

Lode Gold Deposits of Ymir-Nelson Area, British Columbia

INTRODUCTION

Ymir-Nelson area, comprising about 380 square miles, was an important producer of lode gold many years ago and has experienced a revival of interest in recent years. Nearly twenty years have elapsed since geological work was done in the area, and the object of the investigations leading to this report was to study the ore deposits in the light of recent mine development. The area is in southern British Columbia and is bounded by longitudes 117 degrees and 117 degrees 30 minutes and latitudes 49 degrees 15 minutes and 49 degrees 30 minutes.

The area is readily accessible. Nelson, on the Canadian Pacific railway and the southern Transprovincial highway, acts as a distributing centre. A branch line of the Great Northern railway which follows, in part, the valley of Salmo river, passes near the main productive mines. A highway from Nelson to Spokane also traverses the area and connecting branch roads lead to many of the properties.

Power lines of the West Kootenay Power Company lead to a number of the producing and operating properties in Ymir and Salmo districts and are close to many other properties that are not operating. Power may, in consequence, be said to be available to most of the properties in the district at a reasonable capital expense.

The writer acknowledges with thanks the co-operation and assistance received from the staffs in charge of the various mining properties. Particular thanks are due to Messrs. Arthur and Harold Lakes of Wesko Exploration and Development Company for placing at his disposal not only the plans of the property being developed but also the plans of properties they had previously examined. During the course of the work the writer was assisted by Messrs. H. L. McCallum and Delyle Boese, who performed their duties in a capable and satisfactory manner.

The mining history of the area dates from 1885 when the first locations were made. The Silver King mine on Toad mountain, staked in 1886, furnished the actual start of mining operations. However, for some years, chiefly owing to the boom at Rossland, prospectors did not pay much attention to the area. In 1896 many of the now well-known claims were staked and two years later Ymir camp began to attract considerable attention. This activity lasted for six or seven years, after which many properties were worked intermittently over a long period. In Nelson district activity appears to have continued longer. Recently, the rise in the price of gold, the success achieved by several properties, and the activity exhibited by the neighbouring Sheep Creek camp have combined to attract further attention to the Ymir-Nelson area, so that more properties are being

developed or examined there than has been the case for years. Many former producers are being re-examined or are having work done on them; several new mills have been constructed and some of the properties have, apparently, reached the stage of sustained production.

Many of the properties in the area have been idle for years and on others assessment work only has been done. All operating properties were visited and as many prospects as time permitted.

GENERAL GEOLOGY

The general geology of the area has been treated by the following writers and only the more important points bearing on the mineral deposits will be given here. A map by McConnell and Brock¹ shows the regional geology. In 1911 LeRoy² mapped the geology of Nelson area, and in 1914 Drysdale³ the geology of Ymir area. A report on Salmo map-area to the south has been written by Walker⁴.

The mineral deposits of the area occur mainly in rocks of three groups: the Pend d'Oreille, the Rossland Volcanic, and the Nelson batholith.

The Pend d'Oreille group consists of metamorphosed sedimentary rocks, argillites, quartzites, quartz mica schists, and crystalline limestone. Altered tuffs and greenstones occur sparingly. These rocks strike roughly north conforming in a general way with the north-south border of the granitic masses. The most important belt extends northward from Ymir. Walker⁵ places the group in the late Precambrian.

A wide belt of rocks occurs to the west of the Pend d'Oreille group, extending from the southern border of the area to near Nelson. This group is referred to as the Rossland Volcanic group. However, in Salmo map-area immediately to the south Walker⁶ has applied the name Beaver Mountain-Rossland group and points out that "the Rossland group is so intruded by rock, similar to that comprising the flows of the Beaver Mountain volcanic group, as to render it impossible to differentiate them on a map on a scale of 1 mile to the inch." As the rocks mapped by Walker continue into the area under discussion, it is considered advisable to point out that members of the Beaver Mountain group may be present with the Rossland volcanics, particularly in the southwestern part of the area near the mass mapped by McConnell and Brock as Beaver Mountain group. The rocks of this belt consist of a complex assemblage of basic volcanic rocks with pyroclastics. Bands of slate, tuff, and limestone occur. Augite andesite, augite porphyrite, hornblende andesite, and augite-feldspar porphyrite are the main rock types. In places these rocks are highly sheared and converted to chlorite schists. Their age is given by Drysdale and Walker as possibly Triassic.

Both these groups are cut by granodiorite of the Nelson batholith, the main mass of which occurs around Nelson. One large tongue of the batholith occurs to the east of the principal belt of Pend d'Oreille rocks. Many

¹ McConnell, R. G., and Brock, R. W.: Geol. Surv., Canada, West Kootenay Map Sheet (1904).

² LeRoy, O. E.: Geol. Surv., Canada, Sum. Rept. 1911, pp. 139-157; Nelson Map-area.

³ Drysdale, C. W.: Geol. Surv., Canada, Mem. 94, Ymir Mining Camp (1917).

⁴ Walker, J. F.: Geol. Surv., Canada, Mem. 172, Geology and Ore Deposits of Salmo Map-area (1934).

⁵ Ibid.

⁶ Ibid., pp. 10-11.

smaller apophyses or dykes occur in the Pend d'Oreille rocks and show an easterly or southeasterly dip towards the large tongue. In places close to the contact with the tongue they are very numerous and cut the intruded rock (Pend d'Oreille schist) into bands ranging from a few inches to hundreds of feet wide.

The most common granitic type in Ymir-Nelson area is a grey granodiorite of medium texture, but variations range all the way from a true granite to quartz diorite. The Nelson batholith is generally considered of late Jurassic or post-Jurassic age.

Slightly older than the Nelson batholithic rocks, but younger than the Rossland volcanics, are a series of granite porphyry tongues believed to be related to some of the ore deposits. They are fine-grained, greenish grey, porphyritic rocks and, in most cases, are much altered and schistose. They intrude the Rossland volcanics on Elise mountain and Hall creek, and are associated with the mineral deposits there.

A small stock of monzonite and pulaskite, occurring near Ymir, is described by Drysdale and assigned by him to the Tertiary. This and bodies of Rossland alkali granite and alkali syenite mapped by McConnell and Brock represent a Tertiary period of intrusion that has been related to the Coryell batholithic invasion. ← Sp

Numerous dykes of syenite porphyry, granite porphyry, quartz porphyry, and lamprophyre have invaded all but the youngest of the rocks described above. Drysdale assigns them to the Tertiary. Some of these cut the vein deposits and some occupy post-mineral faults.

ECONOMIC GEOLOGY

The ore deposits may be divided into several groups according to their mode of occurrence and mineral content. These groups are not sharply defined and there may be some uncertainty as to the group to which individual deposits belong.

(1) *Fissure Vein Deposits in Pend d'Oreille Rocks.* The gold content is of greater value than that of any of the other metals. Some of the deposits contain pyrrhotite, but none of them so far as is known contains copper minerals. The ore forms well-defined shoots in which high gold content is commonly, but not always, associated with high galena, and probably also with high sphalerite, content. The veins of this group strike from north 60 degrees east to nearly east and dip 50 to 70 degrees northwest.

Deposits of this type rank high in the past production of the area. This type is exemplified by the Ymir, Yankee Girl, Dundee, Centre Star, Goodenough, Wilcox, and other mines. Many veins occur in fault zones that strike from north 30 degrees to about north 50 degrees east and such veins have not yet been proved to contain commercial shoots of gold ore, although some silver occurs. It should perhaps be emphasized that these remarks apply only to deposits occurring in the Ymir belt, that is, to the belt of Pend d'Oreille rocks and associated granitic intrusives passing through Ymir. They do not apply to the belt of Rossland volcanic rocks nor to the granitic intrusives farther north, where the veins are classed

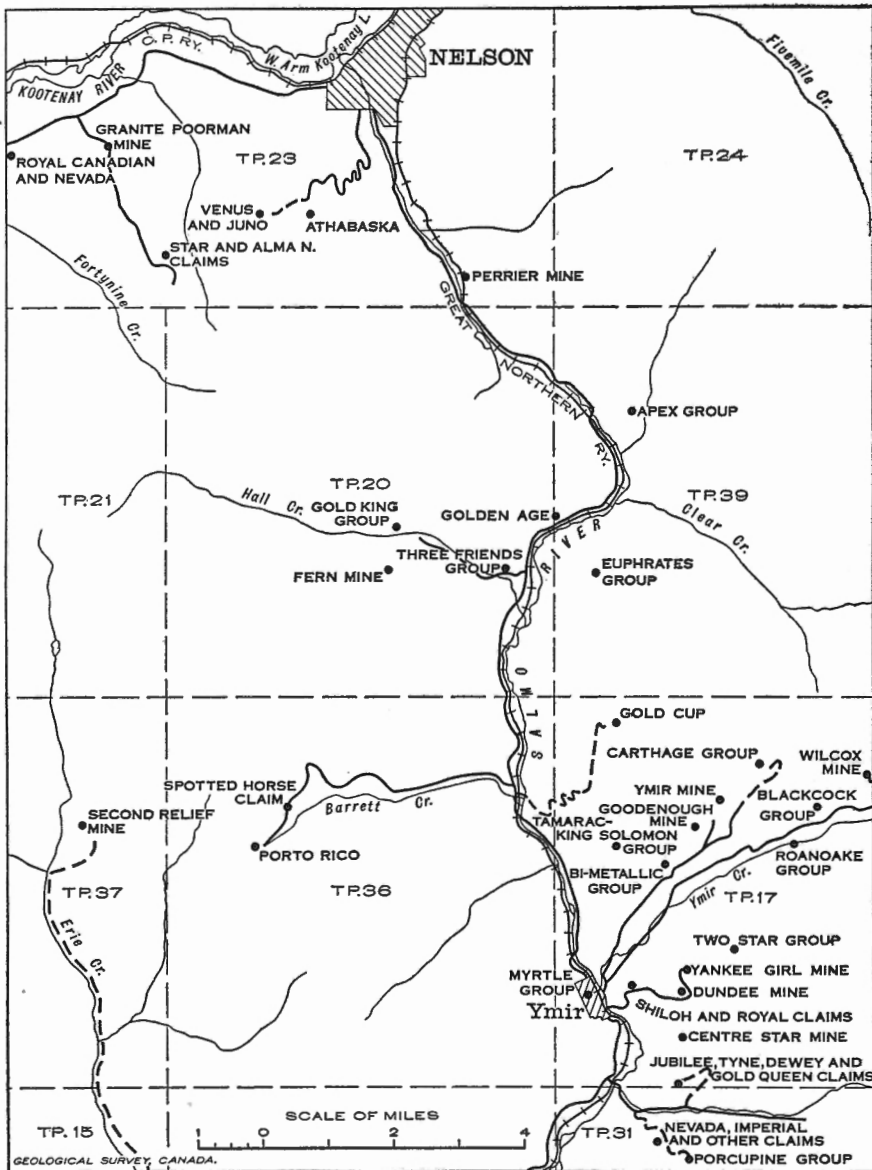


Figure 1. Ymir-Nelson area, Kootenay district, British Columbia, showing location of properties described in Memoir.

under a different type. Although the gold deposits near Ymir have a different strike from the less valuable mineral deposits occupying faults and shear zones, the value of the deposits is related not to the strike but to the fractures in which they occur. In the Ymir belt the northeasterly structures are wide zones of faulting evidently connected with regional movements. They parallel closely the direction of Salmo valley below the town of Ymir. Some are mineralized, but, so far, have not shown commercial shoots of gold ore. They may dip to the northwest, as do the productive veins, or to the southeast. Some of the veins are terminated by such northeasterly fault zones, and the Yankee Girl vein appears to turn and merge with one of these zones, the Lakeview "vein." The vein at the Centre Star runs diagonally between two northeasterly fault zones which carry little or no mineral. Short offset vein segments appear in places in the fault zones and maintain their vein strike, north 60 to 80 degrees east. The suggestion is that the faults were pre-mineral but that some movement continued along them after the formation of the veins. If the faults are pre-mineral the gold mineralization did not penetrate along them to any great extent. There is, however, the possibility that the mineralization along the northeasterly fault zones represents a different stage from that of the gold veins. Recent sampling, by Wesko Exploration and Development Company, of a number of these fault zones where galena and zinc blende occur showed appreciable silver but only small amounts of gold, whereas a similar type of mineralization in the northeast by east fissures would generally be coincident with high gold. Faulted parts of a single vein have not been identified with certainty on both sides of one of these northeasterly fault zones. In the few cases where veins have been found, with large apparent offsets, on opposite sides of these fault zones, the explanation may be that another parallel vein has been encountered. The productive parts of some of the veins, as, for example, on the Yankee Girl property, are close to the intersections of vein fissures with the northeasterly fault zones. Ore shoots are commonly found, too, where the veins intersect tongues of granodiorite and many ore shoots have one or both walls formed of granodiorite. In general the ore shoots pitch eastward towards the main granodiorite mass and, it is assumed, in the direction from which the mineralizing solutions entered; but the factors determining the actual deposition of the ore mineral were apparently highly selective, for ore shoots terminate in some cases abruptly and without apparent reason.

In some instances, notably at the Centre Star mine, the veins are cut and offset by northwesterly faults. These are definitely post-mineral faults and have been demonstrated to be of the normal type.

(2) *Vein Deposits in the Rossland Volcanic Group.* The veins present more variation in type than do the fissure veins in the Pend d'Oreille group and associated intrusives. Direction of strike is not nearly so uniform, although the veins generally strike northeast or north. Pyrite and chalcopyrite appear in some and these two minerals, together with pyrrhotite, or, more rarely, arsenopyrite, in others. Very commonly the veins are associated with minor intrusives of granite porphyry or diorite

porphyry. At the Second Relief mine the vein follows the upper contact of a dyke of diorite porphyry for nearly 2,000 feet. The vein occurs in the greenstones of the Rossland Volcanic group, but in no place is more than a few feet from the dyke and, in places, cuts across minor projections from it. Sheared granite porphyry occurs at the Fern mine; the Gold cup fissure cuts across tongues of granite porphyry; and an augite kersantite dyke follows the vein on the Porto Rico property. Some veins, however, occur at considerable distances from these minor intrusions. Quartz is the chief gangue mineral. Magnetite, epidote, and garnet were noted in the gangue at the Second Relief mine, and molybdenite is reported to occur with the ores. Specularite was noted in the Gold Cup and several other veins, and free gold is reported from many. The suite of minerals at the Second Relief deposit are those of a typical contact metamorphic deposit. In this case, however, the deposit is a fissure vein, occurs in the contact zone of a granitic dyke, and might be expected to carry, in its gangue, minerals associated with the contact metamorphism of the dyke. Such deposits are believed to be of a high temperature type; probably higher than those of group 1.

The veins of group 2 are cut by northwesterly faults. Such a fault, on the Second Relief property, has a horizontal displacement of 96 feet and is of the normal type; another, affecting the Fern vein, has not been solved.

The veins of this group are, in general, narrower than the better known veins of group 1. The ore, where shoots occur, is mostly high grade and values are chiefly in gold. In general, though, the deposits have not received the attention devoted to those of the previous group.

(3) *Fissure Veins Carrying Galena, Pyrite, and Zinc Blende in a Quartz Gangue, with Values Chiefly in Silver.* Veins of this type have been described with the deposits of group 1. Examples occurring with intrusions of monzonite have been discussed by Drysdale and were not examined by the present writer.¹

(4) *Vein Deposits and Mineralized Shear Zones.* These carry quartz and pyrite and, in some instances, small amounts of chalcopyrite, galena, and zinc blende. Many of these are nearly identical with deposits of group 2. Quartz is the chief gangue mineral and pyrite the chief metallic mineral. Free gold is a conspicuous constituent and, locally, chalcopyrite or galena and zinc blende occur. The veins form an important group around Nelson and cut both the Rossland volcanics and the Nelson granodiorite. In some instances they pass from the one formation into the other as in the cases of the Venus and Athabasca veins. Many veins split to include horses of country rock. Some occur in shear zones. These shear zones may conform with the foliation of the enclosing rocks or may dip across the foliation. In other cases their trend is uncertain. The shear zones have generally poorly defined walls and, to date, have received comparatively little exploration. Minerals are not confined to the quartz, but occur also in the sheared country rock. Locally, free gold is abundant at the surface, as a result, it is thought, of surface enrichment. Average

¹ Drysdale, C. W.: Geol. Surv., Canada, Mem. 94, Ymir Mining Camp (1917).

assays are probably low in the mineralized shear zones, but as some of the deposits are wide they may merit more attention than they have received.

The veins of this group are generally narrow, but in some are remarkably persistent, horizontally. Many of the veins have been lost at moderate depths, but in some of these cases the exploration done has not been sufficient to prove conclusively whether the vein has died out, or has been lost through a change in attitude or through faulting.

DESCRIPTION OF PROPERTIES¹

(1) Second Relief Mine

References: Ann. Repts., Minister of Mines, B.C.: 1904, 1919, 1927-30, 1933, 1934.

This property is owned by the Relief-Arlington Mines, Limited, which, in turn, is controlled by Premier Gold Mining Company, Limited. It is on Erie creek about 13 miles from the village of Erie on the Great Northern railway. The mine camp, at an elevation of 3,650 feet, is connected by road with Erie.

This is an old property and has been operated intermittently for years, generally by lessees. In 1929 the Second Relief Mining Company, Limited, was amalgamated with the Arlington Mining Company to form the Relief-Arlington Mines, Limited, and in 1934 the Premier Gold Mining Company, Limited, secured control. The Arlington mine lies south of the Second Relief mine and outside the area covered by the present report. It is described by Walker.²

The accompanying figure (No. 2) shows the claims, general geology, and the location of the principal mine entrances. The area containing the veins is underlain by the rocks of the Rossland-Beaver Mountain group, which here consist of greenstone, slate, tuff, and argillite. This group was subdivided into two units; one comprising rusty-weathering greenstone, slate, tuff, and argillite, and the other consisting entirely of greenstone. The rusty band formed by the former is quite apparent from a distance, as the area surrounding the mine has recently been burned over. There is no definite contact between the two units and, so far, it has been impossible to distinguish the greenstones of the two units underground and thus to draw a contact between them. Slate and argillite, as will be pointed out later, have had an important influence on ore deposition, and it was considered important to outline the areas in which they occur. Owing to scarcity of outcrops no section of this composite unit could be obtained. Scattered outcrops have suggested that bands of slate, argillite, and tuff are intercalated with numerous bands of greenstone. At the surface the sediments dip eastward at moderate angles, but underground they have been found dipping steeply to the west.

¹ Properties are arranged in a general geographic sequence from the southern to the northern parts of the area and are numbered to correspond with the numbers on the index map giving the positions of properties.

² Walker, J. F.: Geol. Surv., Canada, Mem. 172, Geology and Ore Deposits of Salmo Map-area, p. 75 (1934).

The greenstone bodies from which specimens were selected for petrographic study are fine-grained, greyish green rocks showing no crystals with a hand lens. Under the microscope they are seen to consist of crystals of feldspar, or of hornblende and feldspar, in a very fine-grained and altered groundmass. Where determined the feldspar is andesine. The hornblende has been mostly altered to chlorite. Other secondary minerals include considerable quartz and some calcite. Such rocks may be called hornblende andesites.

About half a mile north of the mine the rocks of the Rossland-Beaver Mountain group are invaded by a large body of granitic rocks of the Nelson batholith. The intrusives are light grey and medium to coarse grained. One specimen examined under the microscope was a typical granodiorite consisting, essentially, of orthoclase, plagioclase, hornblende, and minor amounts of quartz.

The other rocks seen on the property are dykes. One group consists of diorite and diorite porphyry and is pre-mineral. A prominent dyke of diorite porphyry, striking northeast, is followed by the main vein. It is a speckled rock consisting of phenocrysts of white oligoclase in a fine-grained, dark groundmass partly altered to chlorite. A specimen from near the vein differed by containing more quartz and by containing epidote.

Another small dyke of the same type but striking northwest occurs on the Argenteuil claim. It is a dark greyish green, holocrystalline, fine-grained rock containing hornblende, altered plagioclase, and a little pyroxene.

So far as is known most of the other dykes are younger than the vein deposits and strike north to northwest. The common types are granite porphyry and quartz porphyry. There are also several mica and hornblende lamprophyre dykes. Some of the quartz and granite porphyries have a light-coloured, and others a dark-coloured, groundmass and although these are believed to be but variations of the same rock, conflicting evidence as to relative age was obtained. On the fifth level of the mine a light-coloured, somewhat silicified quartz porphyry is cut by a quartz porphyry with a dark groundmass. Elsewhere, however, the light-coloured dykes hold rounded nodules of rock which is indistinguishable from the darker coloured types. It is believed that the colour of these rocks is dependant upon their rate of cooling and that all belong to the one period of intrusion, though in places cutting one another. The dark-coloured porphyries cut and offset the vein. The light-coloured types are chiefly grey, but include some slightly brown or slightly pink rocks and contain visible crystals of quartz, white or pink feldspar, and hornblende in a fine-grained, in some cases granitic, groundmass. Under the microscope are seen large crystals of oligoclase containing numerous inclusions; smaller crystals of quartz, of orthoclase, and of hornblende largely converted to chlorite. A specimen of light brownish rock with visible crystals of quartz showed under the microscope, phenocrysts of quartz, orthoclase, and oligoclase in a very fine-grained groundmass through which are areas of secondary quartz and minute crystals of feldspar. Another specimen, examined microscopically, showed phenocrysts of orthoclase and quartz with shreds of biotite in a groundmass of fine laths of feldspar, occasional spherulites, and considerable calcite. Part of the groundmass consists of intergrown quartz and feldspar.

The porphyry dykes with a dark groundmass contain visible crystals of quartz and feldspar in a very fine-grained, greenish grey groundmass. A dyke with a grey to greenish, fine-grained groundmass contained phenocrysts of quartz, feldspar, and hornblende. Another dyke with a fine-grained greenish groundmass contained phenocrysts of orthoclase, plagioclase, and quartz, shreds of biotite, and crystals of pyrite in a groundmass of feldspar and quartz, calcite and chlorite.

Only a few lamprophyre dykes were seen. They are deemed to be the youngest of the dyke rocks, but little evidence as to their age was obtained other than that one of them cuts the Second Relief vein. Two dykes of mica lamprophyre were found in the northwestern part of the area mapped. These were not examined under the microscope, but, on macroscopic examination, are similar to the mica-lamprophyre dykes common elsewhere in the camp. They are dark green to black, fine-grained rocks with visible crystals of mica easily weathered to a partly coherent rock which is easily gouged with a pick. One of them was found cutting the rocks of the Nelson batholith. The other lamprophyre dyke was observed near station 15 on the 5th level of the mine. This is a fine-grained, black dyke with none of the constituent minerals distinguishable in a hand specimen. Under the microscope the rock shows fine, needle-like laths of hornblende and individuals of plagioclase feldspar. The rock is holocrystalline with a slight suggestion of ophitic texture.

The ore deposits are fissure veins occurring, chiefly, in the greenstone of the Rossland volcanics. The veins strike northeast and dip, generally, to the northwest at steep angles. The ore minerals consist of pyrite, pyrrhotite, and chalcopyrite. Molybdenite has also been reported. The gangue is country rock and quartz carrying some magnetite and, in places, garnet and epidote. Principal values are in gold and average about 0.4 ounce a ton.

One vein, known as the Second Relief vein, has been developed extensively and has supplied almost all of the production of the mine. The vein follows the hanging-wall of a diorite-porphyry dyke (See Figure 2). This dyke varies from 30 to 40 feet wide. Its upper contact is slightly irregular and small tongues or projections run out into the greenstone. The vein cuts across these projections showing that it was formed subsequent to the intrusion of the dyke. In some places it leaves the dyke and is wholly in greenstone, but is very close to the dyke contact. The vein varies in width from a few inches up to 13 feet and consists, at its widest, of hanging- and foot-wall strands with a horse of country rock between. Where seen by the writer the average width was probably slightly less than 2 feet. The vein and diorite porphyry are cut by dark-coloured quartz or granite porphyry dykes. In the upper levels of the mine these dykes cross the vein directly and, in places, follow faults that offset the vein a few feet; but on the lowest level, No. 6, the dykes, in some instances, enter the vein fissure and follow along it for some feet before passing out on the other wall.

The main vein is opened on six levels. No. 1 level, at an elevation of 4,065 feet, is entered from the surface by a crosscut driven southeast 140 feet to the point of intersection of the vein. A drift is run from the

point of intersection northeasterly along the vein for 385 feet almost to the southern boundary of the Ida D. claim. At the time this work was done that claim was only partly owned by the company so that the vein was not followed into this claim. The section of the vein developed by this working has been stoped to the surface.

No. 2 level, at 3,985 feet elevation, is not an adit, but is accessible by a raise from No. 3 adit. The vein has been followed by drifts northeast for 445 feet and southwest for 420 feet from the raise. The northerly drift terminates at the line of the Ida D. claim. A crosscut about 80 feet southerly from the raise has been driven 320 feet to the southeast. This crosscut has short drifts northerly and southerly on a parallel vein about 220 feet from the main vein. The ore developed by these workings has been stoped to the surface.

No. 3 level, at an elevation of 3,900 feet, crosscuts southeast for 190 feet to the point of intersection with the vein. From the point of intersection a drift has been run northeasterly 1,320 feet into the Ida D. claim with several short crosscuts near its face. A drift has also been run southwesterly 110 feet and a short crosscut has been driven to the southeast near its face.

No. 4 level, at an elevation of 3,795 feet, is a drift for 130 feet to where a fault is encountered. The fault strikes north 25 degrees west and dips 50 degrees southwest. It is a normal fault offsetting the northeasterly part of the vein 96 feet to the right or southeast. A crosscut beyond the fault picks up the vein which is then drifted on to the northeast for 1,200 feet, approximately to the line of the Ida D. claim.

No. 5 level, at an elevation of 3,700 feet, is driven southeasterly for 690 feet and intersects the vein at 250 feet. At 320 feet from the portal a short drift has been run northeast to a winze station. From the point of intersection with the vein a drift has been run northeasterly along the vein for about 1,480 feet. Near the end of this drift both the vein and the diorite dyke enter slates and in doing so the vein swings to the north, nearly in line with the strike of the sediments. The slates at this point dip steeply to the west. Where the vein enters the slates the values disappear.

No. 6 level is reached by a shaft from No. 5 level in the foot-wall of the vein and is approximately 150 feet below No. 5 level. The crosscut from the foot of the shaft to the vein runs northerly and encounters the vein at 120 feet from the shaft station. The vein has been drifted on northeasterly to where it enters the slates. This point lies northeast of the contact of the slate and greenstone on No. 5 level and indicates that the contact is plunging in this direction. The slates, however, dip west. As on No. 5 level, the vein, where it enters the slates, turns to follow them and values disappear. Several faults and dykes on No. 6 level, when related to similar occurrences on No. 5 level, appear considerably to the southwest of their projected position as calculated from dips on No. 5 level, in spite of the fact that the dykes and faults on No. 6 level have the same dip as on No. 5. More information on this problem will, undoubtedly, be obtained in raising and stoping from No. 6 level. A raise to No. 5 had been started at the time of the writer's last visit in September and it was

intended, as soon as possible, to deepen the winze in order to open up new levels.

The ore length on No. 6 level, deducting the width of dykes (75 feet), had been proved for a distance of 1,500 feet. Assay averages up to 3 feet where the vein width is below that figure indicate mill grade ore over that width. The vein has not been drifted on southwest of the crosscut which enters it from the winze station.

The diorite dyke that accompanies the vein has been traced southwest some 800 to 900 feet from the most southwesterly point on the vein explored by the mine workings. It is visible in a short adit driven near the boarding house and is accompanied by a fissure which is, however, not mineralized. Southwest from this point the dyke is lost under the drift deposits of the creek and has not been located on the opposite side of the valley.

Parallel with the Second Relief vein are four veins known as Nos. 2, 3, 4, and 5, lying at 50, 140, 290, and 320 feet, respectively, southeast of the Second Relief vein. These are reported to have given, in general, good assays at the surface, but the small amount of work done on them underground is reported to have given disappointing results.

No. 2 is a narrow vein on the foot-wall of the diorite dyke. It is exposed in several crosscuts through the diorite dyke from the main workings. In the long crosscut from No. 2 level the vein strikes north 60 degrees east and dips 76 degrees northwest. At this point it carries very little sulphide and is only a few inches wide. The vein is also exposed in a short crosscut from the 6th level where it appears as a small stringer of quartz with seams of pyrite in the enclosing wall-rock. The vein has been exposed, too, at other points in the mine not seen by the writer. O'Grady (1933) reports that good assays have been obtained at several of these intersections.

No. 3 vein is only a stringer with no sulphides. Two open-cuts have been made on it about 30 feet apart.

No. 4 vein has been prospected over a length of 50 feet by two open-cuts, and consists of quartz with pyrrhotite and chalcopyrite. It is about 2 feet wide.

No. 5 vein is about 4 feet wide and contains widths ranging from 1 foot to 3½ feet, of massive sulphides, mainly pyrrhotite and chalcopyrite. Very little quartz is present. The vein is exposed for about 40 feet. According to O'Grady (1933, page 236) three samples assayed 0.24, 0.39, 0.36 ounce of gold a ton across 12, 39, and 42 inches respectively. O'Grady notes that these assays are lower than might be expected from the heavy sulphide content and explains "that the absence of quartz has similar characteristics to sections of the main vein, where in some cases, massive sulphides without quartz show lower gold values than anticipated."

Several veins that cannot be related with certainty to those already discussed have been found in the long crosscut to the southeast from No. 2 level. One at the face of the crosscut consists of a 2-inch veinlet of calcite dipping 75 degrees northwest.

Again, at 210 and 230 feet from the main drift in this crosscut, two drifts have been run on two branches of a vein. These drifts unite about

30 feet southwest from the crosscut and continue along the vein for 30 feet in this direction. Northeast of the crosscut the drifts have been run for about 40 feet and are converging at their ends. The drift at 210 feet follows a vein; the drift at 230 feet is along a stringer that splits from the vein. The vein is $2\frac{1}{2}$ feet wide, strikes north 60 degrees east, and dips 80 degrees southwest (or in the opposite direction to the Second Relief vein). It consists of sheared country rock with stringers of quartz and the walls are heavily pyritized. Northeast from the crosscut the vein narrows to about a foot.

The Ida D. vein outcrops about 450 feet northwest of the intersection of the main vein with the Ida D. boundary line. It was not examined by the writer but is stated to have shown good assays at the surface.

On the opposite side of Erie creek, westerly from the Second Relief workings, a vein has been traced continuously for about 800 feet by a series of open-cuts. It strikes north 70 degrees east, dips 75 degrees northwest, and ranges from 1 to 3 feet wide. One strand of quartz, 8 inches wide, occurs on the foot-wall of the vein in the lower part of the lowest open-cut. A horse of country rock, 16 inches wide, separates this from another strand of quartz 14 inches wide. In the upper part of the open-cut the vein is 2 feet wide. The quartz is well mineralized with pyrite.

In the next cut the vein is not fully exposed and in the uppermost cuts, which cover a length of about 30 feet, the vein varies from 1 to 3 feet in width and carries considerable pyrite.

A new 75-ton cyanide mill under construction at the property was expected to be in operation before the close of 1935. The former mill was a flotation plant with a daily capacity of about 40 tons.

The ore and gangue minerals suggest a high-temperature deposit, and the presence of garnet, magnetite, and epidote in the gangue suggests deposition under conditions similar to those of typical contact metamorphic deposits. No study of the paragenesis of the ore and gangue minerals has been made for the purposes of this report. Garnet and epidote were found in the country rock at some distance from the vein deposits and epidote is a common alteration of greenstone throughout the area. It would thus appear possible that the vein, owing to its location along the dyke, intersects the contact zone of the dyke and as a result these gangue minerals are found in the ore. The time of the formation of the vein is fixed as between that of the injection of the diorite porphyry dyke and the injection of the quartz or granite porphyry dykes, for the vein cuts across projections from the former, and is cut and offset by the latter. The diorite porphyry may represent stages connected with intrusion and differentiation of the Nelson granodiorite to which the ore deposits are undoubtedly related, and the dykes cutting the vein may be related to Tertiary intrusives correlated by Drysdale with the Coryell batholith and the Rossland alkali-granite and syenite of the West Kootenay sheet.¹

¹ McConnell, R. G., and Brock, R. W.: Geol. Surv., Canada, West Kootenay Map Sheet, 1904.

(2) Nevada, Imperial, and Other Claims

References: Drysdale, C. W.: Geol. Surv., Canada, Mem. 94, Ymir Mining Camp, pp. 120-121 (1917).

The above claims are on the steep, northerly facing slope of Porcupine creek. The two named are owned by D. E. Grobe and the Georgia, Rio Grande, and Sandaulphon by O. Anderson. The claims are reached by the trail to the Hunter V. mine, leaving the Porcupine Creek road about half a mile from the junction of that road with the Nelson-Salmo highway.

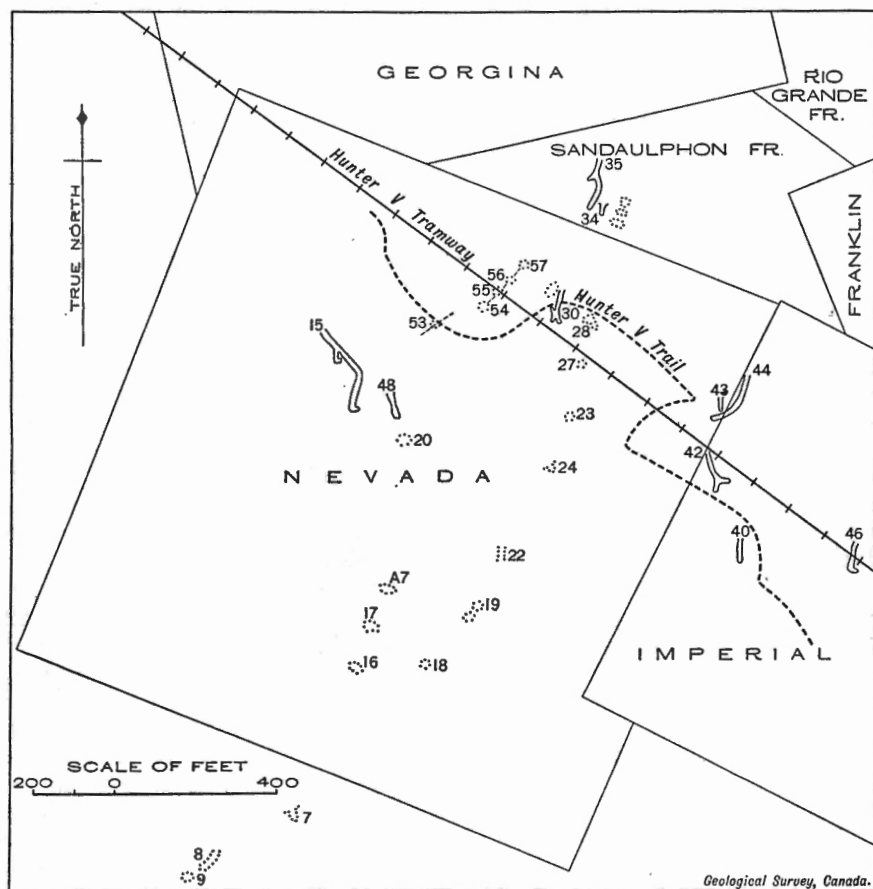


Figure 3. Nevada and adjoining claims, Ymir-Nelson area, Kootenay district, British Columbia. Numbered workings are described in Memoir.

The rocks in the vicinity consist of Pend d'Oreille schists cut by tongues of Nelson granodiorite. Two types of deposits occur on the properties; one, a set of veins striking northeast by east, and the other, northeasterly striking, mineralized shear zones.

The workings are shown in Figure 3, for which the writer is indebted to Messrs. Arthur and Harold Lakes. Numbers referred to below are those on the figure.

One vein is shown by cuts Nos. 53 to 57 inclusive. Its strike varies from north 45 degrees east to north 60 degrees east and its dip from 65 to 70 degrees to the southeast. The vein is 6 inches to 30 inches wide and for most of its exposed length lies in a tongue of granodiorite. It consists of sheared wall-rock containing vein quartz and widely separate patches of fine-grained galena and zinc blende associated with limonite. A fault, exposed in a small gulch, apparently displaces the vein between cuts Nos. 53 and 54. Several, small, northwesterly slips occur in cuts 56 and 57, but apparently do not displace the vein. One sample, across 12 inches at cut 56, assayed 1.20 ounces in gold a ton and 7.20 ounces in silver. Another, 100 feet southwest along the vein, showed no gold and 0.20 ounce in silver. As this vein has the general strike of the gold veins of the surrounding area and as it cuts across one or more tongues of granodiorite it should receive further prospecting.

A second vein almost parallel to the first and 100 feet southeast of it occurs at the portal of adit No. 30. It strikes north 80 degrees east and dips 60 degrees southeast. Only the 4 inches of vein adjacent to the hanging-wall is exposed. It consists of quartz, contains no sulphide, and has not been sampled. The adit itself is driven on a shear zone striking north 30 degrees east and is about 60 feet long, with two short crosscuts near the face. A streak of vein matter 6 inches to 12 inches wide and carrying considerable galena was observed along the foot-wall of the shear zone outside the adit entrance. The mineralized seam cannot be followed far and for most of its length only sheared and oxidized country rock is visible in the adit. At the face a streak, 4 inches wide, carries stringers of quartz. One crosscut at the face follows a northwesterly fault zone which shows pyritic stringers of quartz across a width of 6 inches.

Cuts Nos. 18, 19, 22, 23, 24, 27, and 28 evidently trace a northeasterly shear zone passing 100 feet southeast of adit No. 30. Of these, 22, 24, 27, and 28 are sloughed in so that the vein was not seen, and cut 19 was not seen. In cut 18 the shear zone strikes about north 40 degrees east, dips 80 degrees southeast, is about 4 feet wide, and contains stringers of quartz with bunches of galena in places. Assays totalling \$18¹ in gold and silver are reported by the owners from this cut. Independent sampling by Wesko Exploration and Development Company, Limited, showed only low assays in gold, but a selected sample gave 51 ounces a ton in silver. In cut 23 the zone strikes north 25 degrees east, dips 75 degrees southeast, and is about 4 feet wide. It shows 18 inches of sheared rock, containing stringers of quartz and bunches of galena along the foot-wall. The rest of the zone is more massive rock, somewhat silicified and carrying sparse galena and pyrite.

Cuts 16 and 17 are 150 feet northwest of cut 18 on a shear zone striking north 30 degrees east and dipping 65 degrees northwest. In cut 16

¹ Where assays are stated in dollars in this report gold is calculated at \$20.67 an ounce unless otherwise stated. It should be understood that the writer did no sampling and that values stated are those reported by the owners or operators of properties, or obtained from other sources, which are cited.

the hanging-wall is a mica-lamprophyre dyke. The shear zone is 10 feet wide and is well mineralized with quartz, galena, zinc blende, and pyrite. A picked sample is reported to have assayed 2.41 ounces gold and 29 ounces silver to the ton and 25 per cent lead. Check samples on this cut gave only low assays in gold. In cut 17 there are no defined walls, the shear zone consisting of broken country rock with some pyrite and galena. The zone is about 4 feet wide, but the rock on the foot-wall side also carries some galena, particularly along joint planes. The dyke appearing in cut No. 16 does not occur here.

Cut No. A7 is 100 feet northeast of cut 17 on a shear zone striking north 30 degrees east but dipping 70 degrees southeast. The cut is about 15 feet wide. Towards the centre it exposes 6 feet of badly crushed rock carrying quartz mineralized with pyrite. The wall-rock on the western side carries pyrite and, on the eastern side, both pyrite and zinc blende, so that the total mineralized width is about 15 feet. Only low values in gold were obtained.

A cut, not shown on the figure, lies about 50 feet northwest from No. 17. Here is a shear zone, 4 to 5 feet wide, striking north and dipping 85 degrees west. It consists of crushed country rock sparsely mineralized with pyrite and zinc blende.

In another cut, not shown on the figure, lying about 200 feet southeast of No. 16, a stringer is exposed for 5 feet along its strike, widening to 5 inches in its central part. It strikes north 20 degrees west, dips 75 degrees northwest, and is mineralized with massive galena. In its vicinity the country rock carries numerous gash veinlets of quartz and specks of galena and pyrite appear throughout the rock.

Cuts 7, 8, and 9 are southwest of cut 16. Near the upper end of No. 9 cut, 6 feet of bluish vein-quartz is exposed. The vein walls are obscured. A highly mineralized streak about 6 inches wide and carrying galena and zinc blende strikes north diagonally across the cut and dips 70 degrees west. The rest of the quartz carries only scattered sulphides, largely pyrite.

Cut No. 8 follows a streak of heavy sulphides 6 to 12 inches wide, with gradational walls. A tongue of granodiorite parallels this cut a few feet to the east.

In cut No. 7 a quartz vein, about 1 foot wide, strikes north 80 degrees east, dips about vertically, and cuts the granodiorite referred to above. The vein carries no sulphides. Samples by Wesko Exploration and Development Company, Limited, from the last three cuts showed only low values in gold with silver content running up to 6 ounces a ton.

Adit No. 15 about 250 feet southeast of cut No. 53 is a crosscut for 150 feet to where it encounters a shear zone, 5 to 6 feet wide, striking north 40 degrees east and dipping 80 degrees northwest. The zone is followed about 100 feet to the face where it is offset by a fault striking north 60 degrees west and dipping 70 degrees southwest. The shear zone consists of crushed country rock with veinlets of quartz and some galena and zinc blende.

Adit No. 35, about 300 feet northeast of cut No. 57, is driven on a contact between granite and schist. At 30 feet from the portal a crosscut to the west encounters a shear zone in granite striking north 40 degrees east

and dipping 56 degrees northwest. This was followed to the face of the crosscut. At 66 feet from the portal, and in the main adit, the working starts to follow a well-defined fault wall in the schist but encounters only a little pyrite. At 126 feet from the portal the adit exposes a vein of dark blue quartz, about a foot wide, striking north 17 degrees east, and dipping vertically. The vein carries inclusions of schist and contains pyrite.

Adit No. 40 is the most southerly of a group of four adits 500 to 600 feet east of adit No. 30. It follows a shear zone which is not well exposed by the working. In an open-cut near the adit entrance is a narrow streak of galena, but this is lost immediately within the portal. Another streak, 2 inches wide, shows on the hanging-wall side of the shear zone at the portal; this streak disappears within a short distance, but the fissure continues along the wall of the adit, striking north 20 degrees east and dipping 70 degrees northwest. A quartz vein with the same strike appears in the central part of the shear zone as exposed at the portal, but does not continue along the adit.

Adit No. 46 about 300 feet east of adit No. 40 is on the Imperial claim and has been driven 51 feet commencing on a sparsely mineralized fracture striking north. At 33 feet from the portal the adit encounters a fault zone striking north 40 degrees east and dipping northwest at 61 degrees. The fault is marked by about 12 inches of gouge and breccia. From 33 feet to 51 feet the fault zone has well-defined walls, 3 feet apart but closing in to 18 inches at 51 feet. The fault gouge is on the foot or east wall. At the face about 18 inches of vein matter consists of quartz in a fault breccia of argillite. No sulphide mineralization could be detected. The face of an 8-foot crosscut driven easterly from the end of the adit is in quartz mineralized with a little pyrite. The strike and dip of this vein matter could not be determined. Assays from the dump gave only traces of gold and silver.

Except for one assay, obviously from a picked sample, the results of sampling of this property, made available to the writer, lead to the general conclusion that the northeasterly shear zones, so far as explored, do not carry gold in commercial quantities. The hope, therefore, of finding gold on the property lies chiefly in the exploration of several veins striking from about north 50 degrees to north 80 degrees east. It is probable that as further work is done on the property other such veins will be found.

(3) Porcupine Group

The Porcupine group adjoins the Nevada group and is located about 2 miles east of the junction of Porcupine creek and Salmo river. It consists of seven claims, four of which, the Porcupine, Champagne, Franklin, and Sunrise are Crown-granted. The owners are E. P. Hauketahl, W. Petersen, and Nels Petersen. The workings are a short distance from the Porcupine Creek road. There are five short adits about 50 feet apart, vertically, except for the two lowest, Nos. 4 and 5, which lie at about the same elevation. All apparently are driven on different mineralized shear zones. Information as to values is generally lacking. The group was examined by the writer's assistants.

The uppermost, or No. 1, adit is driven from an open-cut and follows a mineralized shear zone. The zone is about 12 feet wide, strikes north 35 degrees west, and dips 55 degrees to the southwest. It is mineralized with pyrite, galena, and zinc blende. About 10 feet farther east is another cut on the shear zone which is displaced about 10 feet from its projected position. This cut exposes the zone for 15 feet. At both cuts the country rock is the schists of the Pend d'Oreille group.

No. 2 adit is in about 100 feet. It reaches a shear zone at about 50 feet from the portal, and drifts on this. The zone strikes north, dips 25 degrees west, is about 15 feet wide, and consists of sheared country rock containing bunches of quartz, well mineralized with pyrite. Two small quartz veins appear in the shear zone but cannot be traced for any distance. High-grade galena ore in bunches about 3 feet long was mined from this working. Assay returns showed the galena to run 70 per cent lead and 179 ounces of silver a ton. Galena was seen only in specimens lying on the dump.

No. 3 adit has been driven 40 feet southeast along a shear zone. At the portal it is 6 feet wide, strikes south 20 degrees east, and dips 47 degrees to the southwest. A quartz vein, 10 inches wide and well mineralized with pyrite, galena, and zinc blende, lies on the east side of the shear zone. A 5-foot crosscut at the end of the drift does not expose the vein. About 30 feet east of the portal a 4-foot pyritic quartz vein striking north 50 degrees west and dipping 40 degrees southwest is exposed for 10 feet in an open-cut.

No. 4 adit follows a shear zone striking north 30 degrees west and dipping 53 degrees southwest. This has been drifted on southerly for 171 feet. The zone consists of brecciated country rock with some stringers of quartz. At 115 feet from the portal the breccia is mostly replaced by quartz sparsely mineralized with pyrite.

No. 5 adit is a short distance east of No. 4 and at about the same level it has been driven 57 feet southwest in a mica lamprophyre dyke which strikes north 30 degrees east and dips 70 degrees northwest. A quartz vein sparsely mineralized with pyrite, and about 2 feet wide at the portal, follows the wall of the dyke but disappears about 20 feet from the portal.

About 50 feet east of No. 5 level an open-cut exposes a pyritic quartz vein for 25 feet. The vein strikes north 80 degrees west and dips 60 degrees northeast. At the east end of the cut the vein is 6 feet wide, but tapers to 3 feet at the west end.

(4) Jubilee, Tyne, Dewey, and Gold Queen Claims

Reference: Drysdale, C. W.: Geol. Surv., Canada, Mem. 94, Ymir Mining Camp (1917).

The Jubilee Crown-granted claim is owned by a resident of California, the Tyne and Dewey Crown-granted claims and the Gold Queen, held by location, are the property of S. Carwin of Ymir. The claims lie on the steep, southerly slope of Jubilee mountain, facing Porcupine creek, and are reached by a well-graded road, in poor condition, from the Porcupine Creek road. They were examined by the writer's assistants.

The rock formations are those of the Pend d'Oreille group intruded by tongues of granodiorite from the Nelson batholith. The veins belong to the group of northeasterly trending veins, already discussed, and sampling by Wesko Exploration Development Company showed small values in silver and very low values in gold. They are mineralized with pyrite, galena, and zinc blende.

The uppermost working is an adit on the Tyne claim. It is driven about 100 feet on a quartz vein, 6 to 10 inches wide, striking north 35 degrees east and dipping 65 degrees southeast. Samples have assayed from traces to 0.05 ounce of gold a ton and from traces to 2.1 ounces of silver a ton.

About 1,000 feet southerly from the above adit and on the Jubilee claim, three open-cuts expose a vein of blue quartz striking north 40 degrees east and dipping 80 degrees northwest. The vein is traced by the cuts for about 50 feet and in that distance varies from 3 to 8 feet wide. It is mineralized with pyrite and contains low values in gold and silver. Several other blue quartz veins on the Jubilee claim have approximately the same strike and appear in a group of cuts about 220 feet southwesterly from the last showings. The values are negligible. One hundred and forty feet farther southwest a cut shows a badly weathered quartz vein, 12 inches wide, in gneissic granite of an acidic type. The vein strikes north 40 degrees east and dips westerly. It does not carry sulphides and a sample gave only traces of gold and silver. One hundred feet southwest of this cut is a shaft 90 feet deep but inaccessible. It appears to be sunk on a northeasterly trending shear zone. It is possible that the cuts mentioned are faulted segments of a single vein.

One hundred and forty feet southwest from the shaft and at a lower elevation is an adit, 125 feet long, driven northeasterly along a shear zone in granite. The shear zone is probably the one at the shaft. The adit has a crosscut 25 feet long to the southeast about 20 feet from the portal. The main drift follows a shear zone about 5 feet wide striking north 30 degrees east and dipping 80 degrees northwest. This zone narrows to 12 inches at 33 feet from the portal. At 114 feet the hanging-wall of the zone is well defined and quartz begins to appear. The quartz widens so that the face of the adit is entirely in it, but no sulphides were observed. Samples taken between the point where the quartz was first encountered and the face gave values ranging from 0.01 to 0.04 ounce of gold a ton and traces to 0.60 ounce of silver.

Immediately to the southwest of the above working is a short adit on a shear zone, probably the same zone, in granite and containing two quartz veins 12 inches and 6 inches wide, separated by 12 inches of sheared country rock. Assays gave 0.06 ounce of gold a ton and 0.20 ounce of silver.

Some 200 feet farther south is another short adit along a mineralized shear zone striking north 35 degrees east and dipping 70 degrees northwest. No definite walls are exposed. The zone contains a quartz vein 12 inches wide. Assays range up to 0.08 ounce of gold a ton and 2.20 ounces of silver.

Three hundred feet westerly from this adit, two short adits have been driven on similar shear zones which are, however, offset by faults. Only low values in gold and silver were obtained.

The workings on the above claims are, quite evidently, on north-easterly fault zones such as are described earlier in this report as occurring in association with veins of group 1.

(5) Myrtle Group

The Myrtle group of four claims, owned by S. Curwin and associates, is on Ymir townsite. The workings are confined to the Myrtle claim and consist of an adit, 215 feet long, with a shallow winze and a shaft about 25 feet deep which connects the end of the adit with the surface.

The workings investigate a vein in rocks of the Rossland Volcanic group. The vein strikes north 25 degrees east and dips 50 degrees north-west. It varies from 1 foot to 2 feet wide, but in places the wall-rocks are shattered and carry mineralized streaks. The vein strikes with the schistosity of the country rock, but dips northwest across the foliation which is inclined at 60 degrees southwest.

The vein is picked up at about 90 feet from the portal of the adit and is followed from there to the face, maintaining, in this distance, a width of 1 to 2 feet. In some places the vein consists almost entirely of shattered country rock, but in others streaks of quartz, about a foot wide and well-impregnated with sulphide, occur. Thirty feet from the face a winze is down about 20 feet on a part of the vein well mineralized with sulphides. At this point a foot of brecciated country rock underlain by a foot of well-mineralized quartz adjoins a well-marked hanging-wall. Bunches of quartz, striking and dipping with the schistosity of the country rock, penetrate the foot-wall of the vein. The sulphides appear here and there in masses and streaks both in the vein and in the country rock. One streak, 1 to 3 inches wide of massive sulphides, appears on the south side of the winze.

The shaft is about 35 feet deep, measured along the slope of the vein, and from it a short sub-level is driven northerly about 10 feet from the bottom. In the face of this drift the vein is about 8 inches wide and consists of brecciated country rock with seams of quartz and sulphides. In the shaft, seams of quartz appear through the brecciated country rock for 40 inches from the hanging-wall of the vein. On the south side of the shaft, near the bottom, the vein is intersected by a mica lamprophyre dyke but is not faulted.

The veins consist of pyrite, galena, and zinc blende in a gangue of quartz and country rock. Pyrite is the most abundant of the sulphides, with galena next in importance. It is reported that assays running up to 2 ounces of gold a ton have been obtained in the winze and up to 2.80 ounces a ton in the shaft. A shipment of hand-sorted ore, amounting to 17 tons, has been made from the property and is stated to have given assays of 0.65 ounce a ton in gold and 6 ounces of silver a ton.

(6) Centre Star Mine

Reference: Ann. Rept., Minister of Mines, B.C., 1934.

This property, on the eastern side of Salmo valley south of Bear creek, consists of sixteen claims and is being developed by Wesko Exploration and Development Company, Limited. The elevation of the camp is, roughly, 3,900 feet or about 1,400 feet higher than Salmo valley. A well-graded road with numerous switchbacks branches from the Yankee Girl road and connects the property with Ymir, about 4 miles distant via this road. The property is supplied with power by the West Kootenay Power Company.

The property was staked many years ago, but systematic prospecting only started in the summer of 1934 when the property was acquired by the present operators. Actual construction and development work began late in 1934 and has been pushed rapidly since that time. A camp has been constructed, a road to the property built, two long adits with numerous crosscuts driven, and the right of way for a tramway cleared from the mine to the proposed mill site.

The mineral deposits are veins in the contact zone of the Nelson granodiorite. Though outcrops are not everywhere numerous it is evident that a fairly large mass of granodiorite occurs near the eastern boundary of the Centre Star claim on which the chief workings occur. There are, also, numerous outcrops of this rock southwest of the southern boundary of the claim, but it is not known if these indicate a different body. The larger part of the claim is underlain by argillites and quartzites of the Pend d'Oreille group. These are cut by numerous small tongues of granodiorite and form a broad contact zone with this intrusive. The ore-bodies are found near the granodiorite tongues. A number of dark, easily weathered, mica lamprophyre dykes (the youngest consolidated rocks in the vicinity) cut the veins and follow post-vein faults.

The rock structures are complicated by faults. A number of strong fault zones striking north 30 to 50 degrees east and dipping fairly steeply southeast, cut the formation into fault blocks. Those exposed by mining operations are 15 to 30 feet wide and are somewhat similar to others occurring on surrounding properties as, for example, the Yankee Girl, Dundee, Nevada, and others. These fault zones have the same trend as Salmo valley below Ymir and are probably related to major regional movements. The veins occur in fault fissures striking north 60 to 80 degrees east and dipping 60 to 75 degrees northwest, the main vein-fissure, as explored to date, lying between two of the northeasterly fault zones referred to above. This fissure is also cut by faults striking northeast, north, or northwest. Several mineralized fissures, striking northwest and dipping northeast, enter the main vein-fissure. There are thus two sets of mineralized fissures, one striking northeast by east and the other northwest, and two sets of faults, one striking northeast and one striking north or northwest.

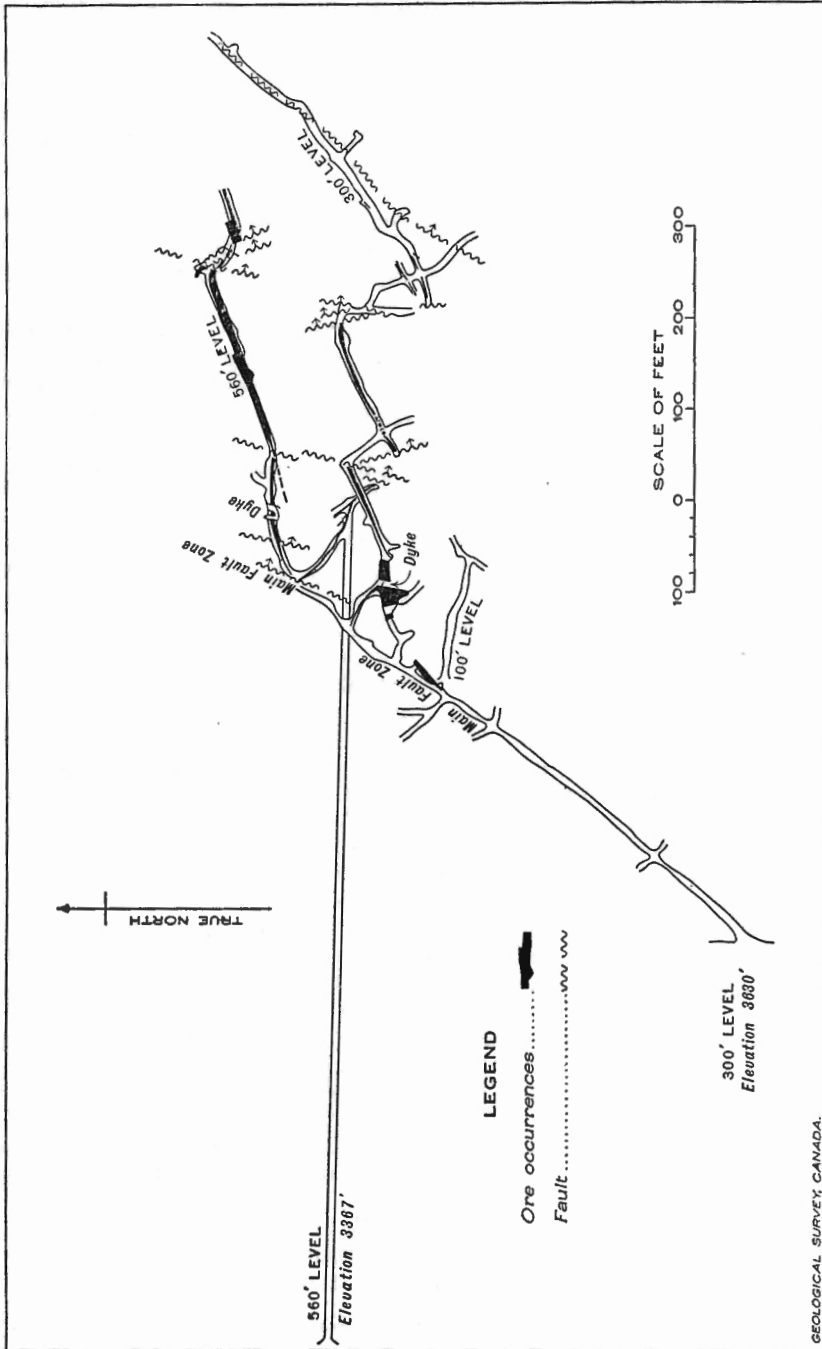


Figure 4. Centre Star mine, Ymir-Nelson area, Kootenay district, British Columbia; plan of workings.

The veins consist of quartz with pyrite, galena, zinc blende, and pyrrhotite. Pyrrhotite is common on the lower level, but is less common on the upper levels. Much brecciated and silicified country rock is included in the veins which vary in width from mere stringers to 25 feet. Ore values are principally in gold, but there is also a content of silver, lead, and zinc. Very high assays of gold are obtained in places, but the average ore is of milling rather than shipping grade. On the surface the veins are thoroughly oxidized and the vein matter consists of honeycombed masses of limonite, quartz, and manganite, together with some pyromorphite¹ stained by cerussite. In part of the 300 level oxidation products were observed in the vein, but for the most part the ore along this level consists of primary sulphides.

Most of the work to date has been on the north vein on the Centre Star claim which consists of a segment of vein lying between two of the northeasterly fault zones mentioned above. Short segments of vein material striking north 60 to 80 degrees east appear in the faults. The distance between the two fault zones is roughly 400 feet, but as the vein cuts diagonally across between these, a length of somewhat over 500 feet is developed on the 300 level. In this stretch the vein is cut by several northerly faults.

Prospecting by surface cuts disclosed several short shoots of ore at the surface in the north vein, and short sections of ore in No. 2 vein. The old prospect adit, No. 1 (See Figure 4), at 4,028 feet elevation disclosed a short shoot of ore near its portal. The 300 level was started by the present operators about 200 feet below the portal of No. 1 adit. It followed one of the major fault zones for about 620 feet and encountered short sections of ore. About 80 feet from the face of this working a northwest-southeast stringer was encountered and was drifted on southeast, widening in this direction until it joined the north vein 50 feet from the fault zone. Here the vein is at its widest, so far as is now known, the width, where crosscut by this working, being 25 feet. Short crosscuts were then driven from the main adit to the southwest of this working and disclosed the vein running back to the fault zone where it is cut off by the fault. The vein narrows considerably as the fault zone is approached. From its wide part a drift was run to the northeast on the vein for 140 feet to where it is cut off by a fault striking north 20 degrees west and dipping 45 to 50 degrees to the northeast. A crosscut to the southeast 50 feet long picks up the vein, showing that the fault is of the normal type. The faulted segment of the vein is then drifted on for 160 feet to where another fault, striking slightly east of north and dipping 40 to 60 degrees to the east, offsets it about 96 feet to the south. The vein, there, appears as two stringers which quickly enter the second, northeasterly fault zone where they are lost. This zone has been driven on for about 300 feet and some diamond drilling done beyond it, but the vein has not yet been found beyond this northeasterly fault zone.

On the 300 level the vein is mostly $2\frac{1}{2}$ to 6 feet wide. In places it is less than a foot wide, in others it ranges from 7 to 8 feet, and in the one short section referred to above, it reaches a width of 25 feet. Three, or

¹ The determination of this mineral was made by Mr. E. Poitevin, Mineralogical Division, Geological Survey.

possibly four, ore shoots are indicated on this level; one, about 40 feet long, where the vein is found against the first or most northerly of the two northeasterly fault zones; the second, 165 feet long, begins near the widest point in the vein but includes a short stretch where values are low; and the third lies west of the second northerly fault and is, roughly, 90 feet long. These ore shoots, if assumed to correlate with sections of ore known at the surface, indicate a rake of about 60 degrees eastward into the hill and a tendency for the ore to lengthen somewhat with depth. Three of the ore-bodies are known to occur where northwest veins or stringers intersect the main vein and the barren or low-grade sections appear in the vein short distances westerly from these cross-fractures. If it be assumed that the ore-bearing solutions entered the vein from the east (or from the direction in which the main granodiorite bodies lie), the explanation of these facts would appear to be that the ore-bodies formed near the intersections of the main vein with these cross-veins and that the mineralizing solutions were dissipated to some extent along these cross-fractures, thereby forming barren sections in the vein beyond to a point where their influence was lost and ore appeared again in the vein. Whether this be the case or whether the cross-veins actually furnished local enrichments to the main vein cannot be determined. In some instances these cross-veins themselves carry important amounts of mineral. The ore shoots are also closely associated with tongues of granodiorite which, in many places, forms one or both walls of the vein at the ore shoots.

A number of lamprophyre dykes occur on this level. One of these cuts through the vein at its widest part. It is distinctly younger than the vein.

The 560 level is 268 feet below the 300 level and crosscuts the country to the northwest of the fault zone followed in on the latter. It is straight to beyond this fault zone which it encounters about 830 feet from the portal. About 100 feet past the fault zone the adit encounters a northwesterly trending vein or cross-vein and follows this northwesterly back to the fault zone. The drift then continues along the fault zone for 30 feet to where the main vein was entered. Drifting was in progress on this vein when the writer left the field and through the kindness of Messrs. Arthur and Harold Lakes, Figure 4 has been extended to include work done on the vein subsequent to his visit. The strike of the main vein on this level is north 80 degrees east and the dip is 65 to 68 degrees northwest, a little flatter than on the level above. Close to the fault zone this vein tapers to a stringer and appears as such in the fault zone itself, where it is offset to the right by slips. The stringer, however, preserves its vein strike. Recent reports are to the effect that as it was followed easterly the vein widened to greater than drift width. It is mineralized with pyrrhotite, galena, and zinc blende and differs from that of the level above in its greater content of pyrrhotite.

The cross-vein, mentioned above, strikes north 40 degrees west and dips 50 degrees northeast. From the point where it was first encountered in the main adit it was drifted on southeasterly about 30 feet to where it is cut off by a fault striking north 20 degrees east and dipping almost vertically. The fault appears to have dragged the vein to the southwest.

This vein is thus exposed for about 130 feet, in which distance it is 1 to 2 feet wide and well mineralized with pyrrhotite, galena, and zinc blende. In places high gold assays have been obtained from this vein, but the writer has no information on average values.

On a small bluff northeast of the portal of this level a shaft has been sunk at the intersection of a vein with a northeasterly fault zone. The shaft is inaccessible, but is reported to be 60 feet deep. The fault zone trends north 30 degrees east, dips southeast, and is consequently about parallel to the other, large, northeasterly fault zones appearing on the property. The vein strikes north 50 degrees east and also dips southeast. It varies from 1 to 2 feet wide, but sampling has shown that the exposed section does not carry appreciable gold values.

Short segments of vein appear on the surface in a fault zone which is correlated with the most southerly of the two, large, northeasterly faults in the 300 level.

Some 300 feet southerly along the road from the portal of this adit a vein, 18 inches wide, striking north 75 degrees east and dipping steeply northwest, is exposed in an open-cut. The vein matter is largely oxidized and is reported to carry appreciable gold values. A vein probably continuous with the last shows on the switchback of the road immediately below. About 1,000 feet southwest of the upper exposure a vein approximately parallel and perhaps continuous with the vein shown by the other exposures is disclosed.

Another vein, known as the Redman vein, is exposed in a small prospect shaft just above the road at an elevation of 3,100 feet and about 900 feet southeasterly from the last vein exposure mentioned. The shaft was full of water and the vein could not be seen.

The northeasterly faults on this property furnish a main problem in development work. Data obtained on this and other properties suggest that these are pre-mineral faults against which the ore solutions were to some extent confined during the period of ore deposition. There is, however, some evidence that, in places, the veins persist into these zones and, in others, that they merge with them, but in either case, that the effect of the mineralization is lost, possibly because of the width of the fault zones and the amount of gouge that they carried. Movement undoubtedly continued along these zones after mineralization, as is shown by the offsets of the small segments of vein that they carry. These segments cannot represent drag ore for, almost invariably, they preserve their true vein strike, i.e. north 60 to 80 degrees east. Whether the veins continue beyond these fault zones is not known and work done looking to the discovery of the veins beyond the fault zones has not been successful, although possibilities in this direction are by no means exhausted. If, however, the faults are pre-mineral, as appears likely, the chances of finding a continuation of the veins beyond them is materially lessened.

Although raises have not yet been put up through the ore shoots, a considerable tonnage of ore is at least indicated by the work that has already been done on the property.

(7) Shiloh and Royal Claims

These claims, owned by J. M. Gille, lie southwest of the Yankee Girl group. The workings are on the road to the Yankee Girl and Dundee groups and consist of a short adit, on the Shiloh claim, driven into the hillside just above the road.

The deposit consists of a mineralized shear zone in argillaceous schists of the Pend d'Oreille group. The shear zone strikes about north 50 degrees west, dips 50 degrees northeast, and consists of crushed wall-rock with veinlets of quartz and calcite containing some pyrite and zinc blende. Galena is reported by Mr. Gille, but was not seen by the writer. The width of the deposit varies from 4 to 7 feet.

The adit mentioned above is about 85 feet long. For 47 feet from the portal it follows the bedding of the argillites which strike north 15 degrees west. It then turns to the west at a pronounced slip and continues for 19 feet, the last seven being in the shear zone referred to above and which, at this point, is heavily mineralized with pyrite and zinc blende. The shear zone was then followed for 31 feet to the face. In this distance it varies from 4 to 7 feet wide, but the sulphides are less conspicuous than where first encountered. Mr. Gille reports that he has had assay results of \$5, \$6, and \$20 a ton in gold, but these are obviously from picked samples. No assay results giving an average for the deposit are known to the writer.

(8) Dundee Mine

This property is on the northern slope of Bear creek southwest of and adjoining the Yankee Girl property. It is connected by road with Ymir, 2 miles away. The property is owned by the Dundee Mining Company, Limited, and is under option to the Ymir Dundee Gold Mining Company, Limited.

The Dundee is described in detail by Drysdale,¹ and only a few notes on recent development are necessary. A plan and sections of the mine are published in Drysdale's report.

The deposit is a fissure vein cutting Pend d'Oreille schist and small tongues of the Nelson granodiorite. The vein is intersected by, and offset by, several lamprophyre dykes. The vein strikes north 60 to 70 degrees east and dips 60 to 70 degrees northwest.

The workings include a shaft 215 feet deep with two levels, known as the 200 and 250, driven from it. These workings are described by Drysdale. The lower level is inaccessible, but some ore has been mined from the upper level and it appears that these workings mark the position of an ore shoot. In addition a long adit crosscuts to the vein and drifts along it at a level of some 900 feet below the collar of the shaft. This crosscut is nearly 1,850 feet long and the drift from it along the vein nearly 1,200 feet long. The drift encountered an ore shoot, about 100 feet long, near the face, and this shoot was found to lie immediately to the west of a fault striking north 25 to 30 degrees east and dipping northwest at 50 degrees. The conditions under which this ore shoot occurs are very similar to those obtaining on the

¹ Drysdale, C. W.: Geol. Surv., Canada, Mem. 94, Ymir Mining Camp, pp. 109-111 (1917).

Yankee Girl property. The fault is approximately parallel to the Lakeview vein of that mine and, by some, is thought to be the continuation of that vein. Although it would take an exact survey to determine this, a rough plotting of the workings suggests that the two features are parallel rather than continuous. Where the ore shoot occurs the foot-wall rock is granodiorite. A raise on the ore shoot, from near the face of the drift, passes out of the ore at 50 or 60 feet above the level and continues for only a few feet above it. It is believed that the ore shoot has an easterly rake and that its continuation upwards should be sought farther west. The face of the adit is 528 feet east of the shaft and there is a probability that an ore zone occurs in the unexplored part of the vein between the shaft and the level. Granodiorite forms the foot-wall of the vein at the collar of the shaft and also appears along the foot-wall of the vein at the ore shoot in the adit. It cannot be asserted with certainty that these are parts of the same body, although it would appear likely that they may be. It is thought that this one tongue, or several tongues, of granodiorite will continue in the unexplored area between the ore shoot in the adit and the ore found in the shaft workings. As intersections of the veins and tongues of granodiorite have proved, elsewhere in the camp, likely places for the occurrence of ore shoots, exploration of the part of the vein between the ore shoot in the adit and the shaft workings would appear to be justified.

The ore-bearing section of the vein has a maximum width of 14 feet and is made up of sheared fragments of country rock cemented with quartz and traversed by veinlets of quartz. The sulphides are pyrite, galena, and zinc blende.

Ore was being shipped during the summer of 1935, but owing to restrictions placed by the smelter on the quantity of siliceous ore that would be accepted the property was forced to close down.

(9) Yankee Girl Mine

References: Drysdale, C. W.: Geol. Surv., Canada, Mem. 94, Ymir Mining Camp, pp. 112-116 (1917). Ann. Repts., Minister of Mines, B.C.: 1919, pp. 132-133; 1920, pp. 129-131; 1926, pp. 275-276; 1927, pp. 277-301; 1928, pp. 327-330; 1929, p. 349; 1932, pp. 186-187; 1933, p. 224; 1934, pp. E 6-7.

The Yankee Girl mine is about 2 miles from Ymir on the northern slope of Bear Creek valley. A disused road branching from the road up Bear Creek connects with the lower or working tunnel of the mine. The mill is immediately across Salmo river from Ymir and is connected with the mine by an aerial tramway. The property consists of the Yankee Girl, Canadian Girl, Lakeview, Black Diamond, Yukon fraction, and Klondyke No. 1 fraction claims.

The early history of the property and plans showing work done to 1914 are given by Drysdale. The claims were staked in 1899 and 1901 and early exploration was done by the owners. In 1907 an American syndicate took an option on the property and did about 1,000 feet of underground work. In 1908, H. L. Rogers bonded the Yankee Girl and Yukon claims, on which he did considerable work, and in 1909 the mine was transferred to the Yankee Girl Gold Mines, Limited, of New York.

In 1911 this company was reorganized and in the following year the property was transferred to the Hobson Silver-Lead Company, Limited, who operated the property until 1919. Shipments of ore to 1914 are given by Drysdale as totalling 8,500 tons with an average value of about \$22. In 1920 the property was optioned to the Mining Corporation of Canada, but the option was later relinquished. Between 1926 and 1929 the property was operated successively by the Yankee Girl, Limited, the Porcupine Goldfields Development and Finance Corporation, Limited, and the Yankee Girl Consolidated Mines, Limited. Work done by the latter company consisted of driving a long crosscut adit from Wildhorse creek, designed to reach the vein at a depth of 765 feet below the lowest or 1,235 level, and the driving of a vertical raise from the 1,235 to the 1,035 level. The raise was planned to connect both the lower crosscut and the upper workings, but was not completed. The company went into liquidation before the crosscut adit had reached its objective and the Yankee Girl property reverted to its owners, the Texas Yankee Girl, Limited. The claims through which the crosscut adit was driven and which were acquired for that purpose, however, are retained by the liquidator of the company and are not part of the Yankee Girl property. In 1932 E. P. Crawford and F. R. Weekes took over the property and later organized the present company, Ymir Yankee Girl Gold Mines, Limited. Shipments of ore were suspended in 1934 in order to break ore for the mill constructed that year. The owners estimate that total shipments of crude ore from the property have amounted to 101,166 tons.

The Yankee Girl vein deposits occur in the contact zone of a mass of the Nelson granodiorite, which trends northeasterly across the camp. At the mine a large number of tongues of this rock penetrate the Pend d'Oreille schists and the main body of granitic rock is probably cut by the extension of the Lakeview vein which lies northeast of the Yankee Girl vein proper. Owing to the heavy drift cover in critical areas it is difficult to map the extent of the granitic bodies at the surface as in places where only outcrops of the granitic rocks are seen it is thought that bands of schist are also present but concealed by drift. This is indicated, too, in the mine workings. The granitic tongues are very irregular and so far it has proved impossible to match up their exposures on opposite sides of the vein fissures on any of the levels and thereby determine the relative direction and amount of the movement along those fissures. Striations on the vein walls pitch at an angle of about 65 degrees to the west, indicating a movement of the country north of the vein fissure to the west and downwards. The vein fault is of the normal type, but the amount of movement is unknown.

The main Yankee Girl vein is in a fissure, generally 4 to 6 feet wide, striking north 60 to 70 degrees east and dipping 55 to 70 degrees southeast with an average dip close to 65 degrees. It averages about $4\frac{1}{2}$ feet wide; has a maximum width of about 30 feet, but in productive sections does not exceed 12 feet. The vein fissure is filled with quartz and crushed country rock and is mineralized with pyrite, galena, and zinc blende. Principal values are in gold, the ore averaging about 0.42 ounce a ton. Appreciable quantities of silver, lead, and zinc are also present. The

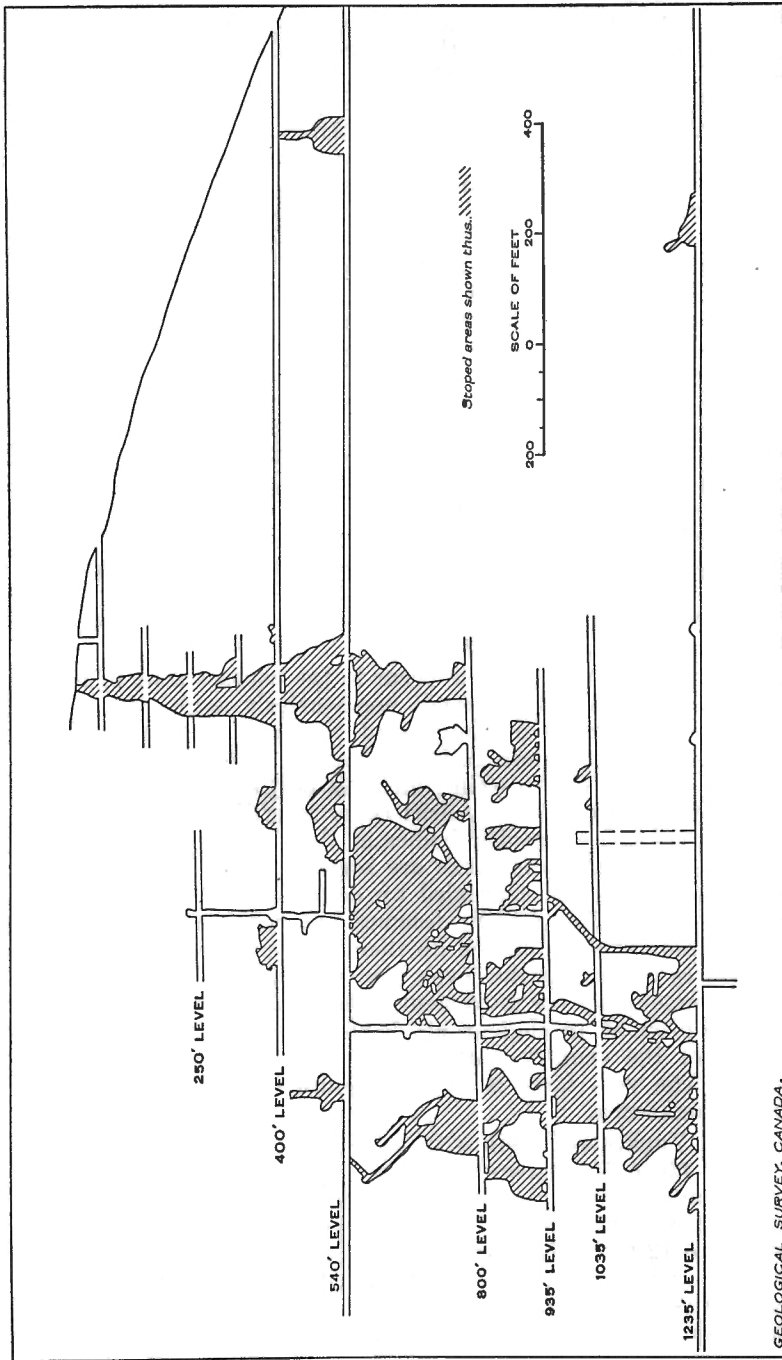


Figure 5. Ymir Yankee Girl Gold Mines, Limited, Kootenay district, British Columbia; section showing stoped areas.

distribution of the values is erratic; some sections are very high grade, but values in these may disappear as rapidly as they enter. In most cases the ore forms fairly well-defined shoots raking to the east.

The accessible workings in June, 1935, are shown on Figure 5. The 1,235 level is the main working adit and on it the Yankee Girl vein has been followed easterly for more than 2,200 feet, reaching the chief productive section in the eastern end of the level. An isolated stope, known as the Yukon stope, occurs over 1,000 feet west of the main productive section and is just above the level. On this level, as on most of the other levels now being worked, the eastern termination of the Yankee Girl vein is against a northeasterly fault zone previously referred to as the "Lakeview vein" and one of many such zones associated with the veins of Ymir and vicinity. On the 1,235 level the Lakeview vein has been drifted on for 450 feet northeast, and some 400 feet southwest, of its intersection with the Yankee Girl vein. It strikes north 30 to 40 degrees east, dips 50 to 60 degrees northwest, and is shown by crosscuts to be 20 to 25 feet wide. The zone carries black graphitic gouge and is impregnated with quartz and well-mineralized with pyrite. The ore is mostly below commercial grade.

Paralleling and on the foot-wall side of the Yankee Girl vein for considerable distances in other parts of the mine is the Spur vein. This is a branch of the Yankee Girl vein. It leaves the latter some 200 feet west of the intersection of the Yankee Girl and Lakeview veins and joins it again about 950 feet farther west. The Spur vein has not been explored on the 1,235 level, but its intersections with the Yankee Girl vein are known. About 250 feet westerly from the shaft crosscut on this level a short drift on a cross-vein between the Yankee Girl and Spur veins partly exposes a vein, about 45 feet south of the Yankee Girl vein, which is believed to be the Spur vein.

At the intersection of the Yankee Girl and Spur veins and close to the Lakeview vein, the combined veins form an ellipsoidal mass of quartz about 30 feet in maximum width and 150 feet long. The quartz is heavily impregnated with pyrite and, in places, values run as high as 0.25 ounce in gold a ton. Average values are stated to be below commercial grade. Wide quartz bodies at the intersection are encountered on the upper levels and appear successively farther west on each level up to the 935 (See Figure 5). This indicates a rake to the east corresponding, somewhat, to the rake of the ore shoots.

There is a vertical shaft between the 1,235 and 1,035 levels with a crosscut on the latter to the Yankee Girl and Spur veins. On this level the Yankee Girl vein is driven on for about 500 feet west of the shaft crosscut. East of the shaft is a section approximately 200 feet long which has not been followed, but beyond this the vein has been entered by crosscuts from the Spur vein drift and is followed easterly for about 800 feet, to its intersection with the Lakeview vein. The Spur vein, on this level, is 4 to 6 feet wide and has been driven on for about 90 feet west and 330 feet east of the shaft crosscut.

The upper levels are reached by a raise extending from the 1,235 level to the 540 level.

The Lakeview vein has been driven on for only a short distance on the 935 level. It contains considerable graphitic gouge and some quartz and pyrite. On this level, too, the Yankee Girl vein has been driven on for about 900 feet and the Spur vein for about 80 feet. The enlargement of vein matter referred to above, just east of the intersection of these two veins, is well shown on this level.

On the 800 level the Yankee Girl vein has been driven on for 950 feet west of its intersection with the Lakeview vein and the Spur vein for about 450 feet west from its intersection with the Yankee Girl vein. The enlargement east of the intersection of the Yankee Girl vein and Spur veins maintains a width of 30 feet for a length of 80 to 100 feet. The intersection is here more nearly vertically above the intersection on the 935 level than the latter was above lower level intersections and from the 800 level up seems to shift slightly more to the east with each, succeeding, higher level.

On the 540 level the Yankee Girl vein has been driven on for about 2,400 feet west of its intersection with the Lakeview vein. At this intersection the Yankee Girl vein appears to turn, and merge with the Lakeview vein. The Spur vein on this level is reached by a short crosscut driven westerly for 150 feet. This work was progressing at the time of the writer's visit and a section of the vein 100 feet long and with an average width of 6 feet had been found to carry upwards of 1 ounce in gold a ton. The vein is oxidized in places on this level, but, in general, oxidation does not extend below the 400-foot level. At the extreme end of the 540 level the Lakeview vein has a reverse dip of 80 degrees.

The 400-foot level was not examined. It is reported to be caved in places.

The position of the ore shoots with relation to the workings is indicated to some extent by the position of the stopes on the accompanying longitudinal section (*See Figure 5*). Except for a few stopes at the western end of the mine, the general rake of the ore shoots is to the east, or into the hill following, probably, the intersection of the Yankee Girl and Lakeview veins. Locally, too, ore shoots occur where tongues of granodiorite are cut by the vein and, in some cases, one wall of an ore shoot is of this rock. An exception may, however, be noted; the high-grade ore shoot, mentioned as occurring in the Spur vein on the 540-foot level, has schist on both walls but is close to a tongue of granodiorite. The actual cause of the control exercised by these tongues of igneous rock on ore deposition is not known. Drysdale suggests that the acute-angled intersections formed between them and the vein is a controlling factor. It is also possible that there was a chemical reaction between the wall-rock and the solutions bearing the ore minerals, or that the tongues may have still been hot when fracturing and ore deposition occurred, thus exercising a temperature control. These points are, however, largely speculative. The principal structural control of ore deposition, in this case, would appear to be the intersection of the Lakeview and Yankee Girl veins.

There is evidence that the Lakeview vein deposits occur in one of these large, northeast, pre-mineral fault-zones, referred to at several places in this report, and that mineralization continued along it but was not sufficiently concentrated to produce commercial ore-bodies. If this interpretation is correct, it follows that the Yankee Girl vein terminates at the

Lakeview fault-zone and need not be searched for beyond. There is, of course, the possibility that the Yankee Girl vein follows the fault zone for some distance and then leaves it on the opposite side, but this can be determined only by further exploration.

There are still sections of the mine that are relatively unexplored and where ore shoots may occur (*See* Figure 5). It is expected, for example, that further ore will be found in the relatively undeveloped sections of the mine above the 400-foot level.

Below the 1,235 level a winze has been sunk 125 feet on the main vein and a new level, known as the 1,360, has been started east and west from the bottom of the winze. It is reported that the vein is continuous to the bottom of the winze and that some ore was found in the drifts, but work had not progressed far enough to block out ore. In the winze at a depth of 20 feet a branch vein turns into the hanging-wall and dips 30 to 38 degrees. It may be similar to the Spur vein.

A mill built in 1934 was put into operation in 1935 and operated steadily throughout the remainder of the year. It is a flotation and cyanide mill with a capacity of 100 tons daily. Reserves of reasonably assured and probable ore are given in the prospectus of the company as 286,600 tons and are estimated to contain 0.47 ounce of gold a ton.

(10) Two Star Group

References: Ann. Repts., Minister of Mines, B.C.: 1933 and 1934.

This group, consisting of the Morning Star and Evening Star and fourteen other claims, was operated by the Trites Gold Mining Company, Limited, in 1933 and 1934. The property was closed down in 1935 and was not examined by the writer. It is located on the northern side of Bear creek about 4 miles, by road, from Ymir. The following information is taken from O'Grady's reports (1933, pages 224-225; 1934, pages E 8-9).

The surface workings consist of open-cuts, tracing a northeasterly vein on the Morning Star and Evening Star claims, and an old winze, elevation 5,144 feet, sunk on the vein that dips 75 degrees northwest. The winze is said to be 95 feet deep and to follow an ore shoot. An adit, at elevation 4,300 feet, was driven 3,135 feet northerly to tap this vein and encountered several northeasterly fissures. One at 1,566 feet is known as the Black Diamond vein and consists of 3 feet of sheared, granitic rock mineralized with pyrite, galena, zinc blende, and a 3-inch stringer of quartz. At 2,130 feet and 2,190 feet, fissures containing stringers 11 and 8 inches wide, respectively, were cut. A drift was run for 190 feet on the latter, but faulting was encountered. At 2,542 feet the Morning Star fissure was intersected. It is 13 feet wide and contains much quartz. At 2,955 feet is a fissure zone 9 feet wide and thought to be either the Yankee Girl vein or, more probably, the Lakeview vein of that mine. This is evidently the downward continuation of the vein on which the 95-foot winze was sunk. Some drifting was done to explore it. Quartz stringers containing pyrite, galena, and zinc blende were encountered and selected samples of these are stated to have given values comparable with the general content of ores in the camp.

(11) Bi-Metallic Group

This group lies on the northern side of Wildhorse creek southwest of the Goodenough property. It is owned by J. Bremner, S. Curwin, S. Baw, and C. McIsaac.

In a small gulch below and to the west of the Goodenough mine a line of open-cuts exposes a shear zone in argillites of the Pend d'Oreille group. The zone varies from about a foot to 12 feet wide, strikes north 25 to 40 degrees east, and dips from nearly vertically to 45 degrees northwest. The open-cuts expose the zone on both sides of the small gulch at intervals over a total length of 400 to 500 feet. The zone consists of brecciated country rock, with bunches of quartz. No sulphides were seen. The shear zone conforms closely with the strike of the enclosing rocks. About 350 feet distant, horizontally, and possibly 100 feet lower, an adit 360 feet long was run to intersect this shear zone. Where cut by the adit the shear zone shows pyritic stringers of quartz in the bedding planes of the argillite. Nothing is known as to contained values.

A second showing is near the bottom of the hill slope a short distance north of the lower switch-back on the Goodenough road at the northerly contact of a tongue of granodiorite with the schists. Here a shear zone 24 inches wide is exposed by an open-cut 6 feet long, and contains a quartz lens 12 inches wide. The lens tapers to 2 inches at the west end of the cut and 8 inches at the other end. It strikes north 80 degrees east, dips 80 degrees northwest, and is underlain by several inches of sheared rock. No sulphides were observed, but the vein does show some limonite. Three other cuts along the strike of the vein and within a distance of 275 feet west of the first have not found the extension of the vein.

Another cut was being put in on a showing some 500 yards to the northwest where float of graphitic gouge mineralized with quartz and pyrite had been found. The source of this material had not been located at the time of the writer's visit.

Ymir and Goodenough Mines

Ymir Consolidated Gold Mines, Limited, was organized to acquire the Ymir and Goodenough properties. Some high-grade ore was known to exist in the Goodenough and sampling of the Ymir indicated that large blocks of low-grade ore remained. On this basis a flotation mill, with a capacity of 125 tons daily, was constructed on the property and was placed in operation in July, 1935. The mill is connected to Ymir mine by a surface tram with electric locomotive haulage, but Goodenough ore must be trucked to the mill.

When milling started the agreements with the owners of the Goodenough called for separate milling of the ore from this property and the initial run was on this ore. Later it was understood that these agreements were modified to permit mixing with ore from the Ymir mine. The results were disappointing. Official figures as to the average gold content of the mill heads from the Ymir mine have not been released but it is understood that they were much below the grade that had been expected. The mill operated for only a few months and closed down. A consultant was called

in to examine the mine for the company and as a result of his examination it was announced that plans were being made for further development work.

(12) Ymir Mine

Reference: Drysdale, C. W.: Geol. Surv., Canada, Mem. 94, Ymir Mining Camp, pp. 100-107 (1917).

The Ymir mine is on the North fork of Wildhorse creek at an elevation of approximately 4,500 feet and about 5 miles from Ymir. A road leads from Ymir to the mill and mine.

No extended description need be given here as the property is fully described by Drysdale, since when no further development work has been done.

The Ymir vein is a quartz-filled fissure striking north 60 degrees east and dipping 60 to 70 degrees northwest. It varies from a few feet to 40 feet wide and, where seen by the writer, was mostly from 5 to 15 feet wide. The vein fissure cuts the Pend d'Oreille schists. Only minor tongues of granodiorite were seen in the workings, but a large one, trending northeast, passes to the east of the vein as exposed in the mine workings and crosses the crosscut adit of No. 10 level. Its dip is not known, but it probably plunges to the southeast towards the main mass of this rock as do other granodiorite tongues in this neighbourhood. The ore consists of pyrite, galena, and zinc blende in a gangue of quartz, and may be regarded as occurring in a single ore shoot extending down to the 7th level. The shoot contains barren sections and has a steep rake to the east. Small blocks of ore appeared on the 8th and 9th levels, but values in the vein below the bottom of the shoot are generally below commercial grade. This section of the vein contains only small amounts of sulphides, but pyrite and zinc blende appear more plentiful than galena. On the 10th level the vein was driven on for about 1,100 feet east of a disturbed zone to where it disappears as a stringer.

The principal problem at the Ymir is whether more ore may be expected by extending underground work either laterally or to depth. There is a possibility for example that a barren zone has been encountered in the present low levels and that other ore shoots may underlie it. Not enough is known of the factors determining the position of the ore shoot that was mined to furnish a definite answer to this question. The productive parts of the upper workings are now largely inaccessible. Drysdale suggests that the position of the groundwater level in previous geological periods may have been the main factor in determining the depth of the ore shoot and, if this should be the case, the chances of finding more ore with depth are not great. There is little evidence to prove or disprove this theory. It is probable that the sulphide content, and particularly the galena content, of the vein on the lower unproductive levels is much less than was the case where the ore was mined. If this assumption be correct it may very well point to the dying out of the mineralization owing to the cause Drysdale suggests.

On the other hand the vein continues strong down to the 10th level and it is of common occurrence to find ore shoots at different elevations in a vein. At the Yankee Girl property the ore has persisted to greater depths

than at the Ymir. The Ymir vein has, however, been explored to a depth of several hundred feet below the ore shoot, and no indications of other ore shoots have been found. There is, therefore, little to warrant further exploration in depth, other than as a purely speculative enterprise.

A second possibility lies in tracing the vein eastwards to where it should intersect the granodiorite tongue referred to above. Such intersections have proved to be productive in other parts of the camp. On the other hand it is known that the eastern end of the vein on the 10th level is pinching out and may not reach the granodiorite tongue. In the last 300 feet on this level the vein gradually narrows from 15 feet to a stringer, which is gradually turning toward a formational strike. These features are interpreted as pointing to the end of the vein, and consequently the prospect of tracing the vein to an intersection with the dyke is not very bright. There is the possibility that the vein may again widen, or that a parallel vein may exist, but these are chances that can be tested only by further work.

A third possibility is based on the belief that at its western end the vein is faulted, and may, in consequence, be picked up beyond the fault. The drift westerly on the 10th level is approaching a disturbed zone and near its west end crosses a prominent fault striking north 25 degrees east and dipping vertically. The fault is marked by a foot of crushed argillite. About 200 feet east of the fault the vein begins to bend to the south of its southwesterly course and a short drift runs along this part of the vein. In it the vein appears as narrow, isolated bands of quartz, more or less discontinuous along their strike, pinching to a mere stringer as the face is approached and swinging to parallel the enclosing formations. It is uncertain whether these facts indicate that the vein has been dragged in approaching a fault zone, or whether it is pinching out on approaching a disturbed zone. A short crosscut has been run southwest on the west side of the fault, without finding the vein. This fault is reported to have been encountered in the upper levels and a long crosscut was run northwest on No. 2 level to the west of it, in search of a vein which, from float found at the surface, was believed to parallel the Ymir vein. No vein was found in this working. With the exception of this working, the area west of the fault may be said to be unexplored.

(13) Goodenough Mine

References: Drysdale, C. W.: Geol. Surv., Canada, Mem. 94, Ymir Mining Camp, p. 95 (1917). Ann. Repts., Minister of Mines, B.C.: 1923, pp. 214-215; 1924, pp. 192-193; 1926, pp. 275-276; 1927, pp. 301-303; 1928, pp. 330-331; 1929, pp. 349-350; 1930, pp. 269-271; 1932, p. 187; 1933, p. 227; 1934, p. E 13.

This property adjoins and lies southwest of the Ymir group. It was staked in 1898 and was optioned in 1899 by the Ymir Gold Mining Company. A shaft was sunk 60 to 70 feet. No further work is mentioned until 1923 when the owners began to explore the property. In 1926 it was optioned to the Porcupine Goldfields Development and Finance Company, Limited; in 1928 to the Enterprise Consolidated Mining Company, Limited; and, later, to the present company.

The Goodenough vein is in Pend d'Oreille schists, cut by a few, narrow dykes or tongues of granodiorite and by several lamprophyre dykes. It

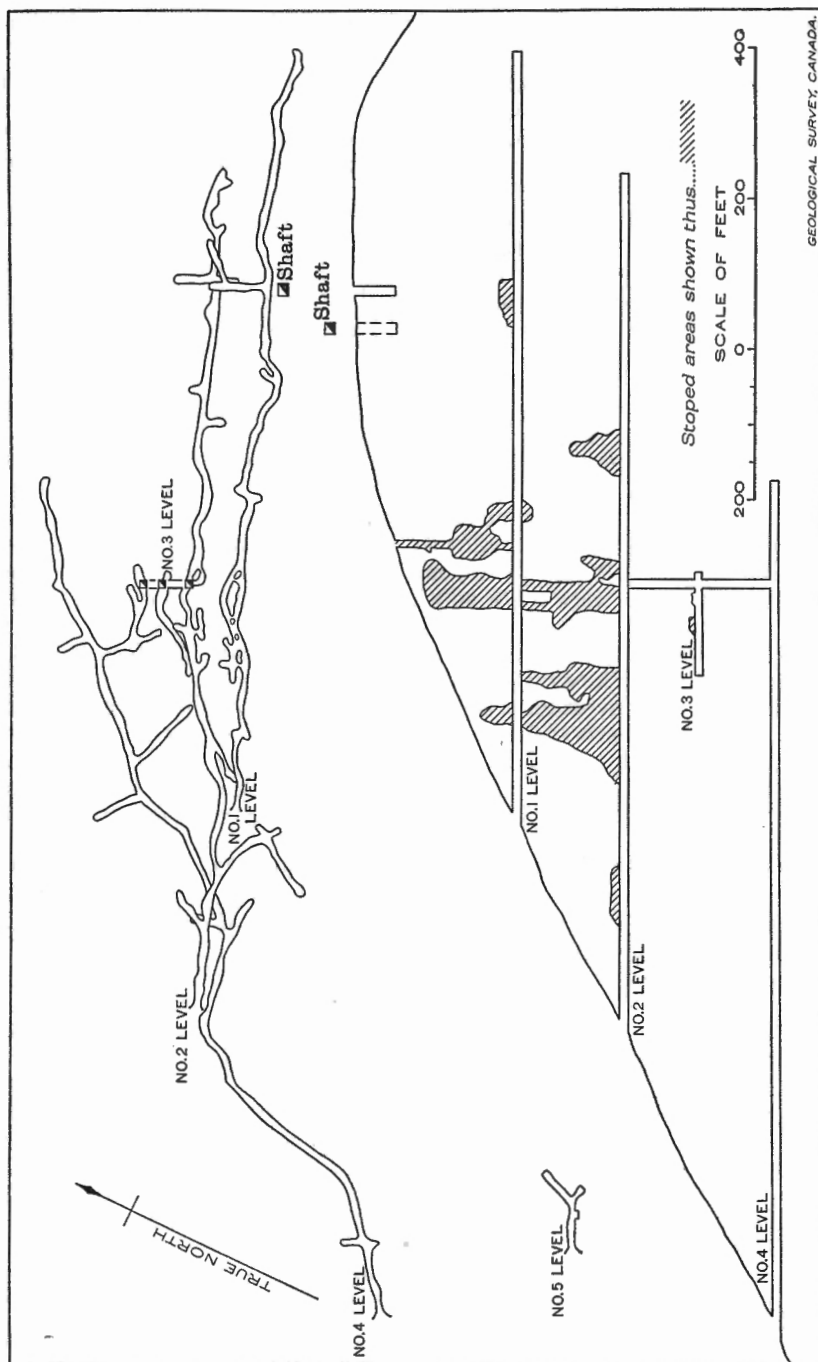


Figure 6. Goodenough mine, Ymir-Nelson area, Kootenay district, British Columbia; plan and section showing workings.

strikes northeast by east, dips to the northwest, and is mineralized similarly to other Ymir gold deposits.

O'Grady (1934, page E 13) gives the past production of the property as 20 tons, in 1898, assaying \$22 a ton; and 4,660 tons between 1926 and 1930 containing 3,993 ounces of gold, 30,283 ounces of silver, and 431,091 pounds of lead. The writer has no record of the production by the present company.

The original workings were two shallow shafts, about 80 feet apart, sunk on the summit of a shoulder of the hill that lies between the Goodenough and Ymir mines (See Figure 6). These shafts are inaccessible. The adit levels are started from the southwestern slope of this shoulder and driven northeasterly towards the shafts. No. 1 level is 225 feet vertically below the collars of the shafts, and has been driven northeasterly along the Goodenough vein for about 1,000 feet. The vein was picked up at about 200 feet from the portal, and at this point is swinging to the south of its general strike. A little farther in the vein splits to form hanging- and foot-wall branches in a sheared zone about 30 feet wide. The positions of the two branches are indicated on Figure 6 by subsidiary drifts and occur over a length of 200 feet, beyond which the branches, apparently, re-unite to form a single vein which is followed for 75 feet easterly and then offset to the north by a small fault. Beyond the fault this single vein is drifted on for 600 feet to the face. Its width in this section varies from a mere stringer to 5 or 6 feet. The stopes shown in Figure 6 indicate the position and general size of the ore shoots encountered. About 300 feet from the face and about under the shafts, mentioned above, a crosscut was driven 75 feet to the north to investigate the vein opened up by the more northerly shaft. At 60 feet the crosscut encountered a strongly sheared zone about 2 feet wide, striking north 50 degrees east and dipping practically vertically. This zone consists of sheared rock, with very little quartz or sulphide, and parallel to the main vein. It has been drifted on northeasterly for 60 feet.

The portal of No. 2 adit is 130 feet below and 275 feet south of the portal of No. 1. The vein was not encountered in the first part of the drive, so a crosscut was run to the southeast and encountered the vein, which, as on the level above, had swung to the south of its general line of strike. The vein was followed back to the southwest for 180 feet, and was an ore shoot for that distance. The main drive was continued northeast, reached the vein at 300 feet from the crosscut, and was driven on it for about 875 feet. As on the upper level, the vein splits to form hanging- and foot-wall sections.

A crosscut was also run from this level to pick up the supposedly parallel shear zone located from No. 1 adit, but was not driven far enough to reach its objective.

No. 3 is a short, intermediate level driven from the raise that connects Nos. 4 and 2 levels. It opened up an ore-body that was being stoped at the time of the writer's visit.

No. 4 level has been driven entirely off the vein, but two crosscuts to the southeast have picked it up. A third crosscut, nearest the portal, does not reach the vein, but short diamond drill holes from the end of the crosscut are reported to cut it. At 40 feet from the adit the second crosscut

reaches a vein striking north 35 degrees east. This vein is about a foot wide and consists of crushed country rock carrying stringers of quartz but very little sulphide. In the third crosscut the vein has been picked up and drifted on to the northeast, in which direction it splits as it did in the upper levels but is not ore bearing. A raise up to No. 2 level encountered ore about 100 feet above No. 4 level. The short, intermediate level was then driven and work in this section of the mine was progressing at the time of the writer's visit.

No. 5, a short adit, is slightly below and 300 feet southeast of No. 4. It follows a vein 14 feet wide and well mineralized with quartz and sulphides. In spite, however, of much sulphide, including considerable galena and zinc blende, the vein is reported to carry only low values in gold. At a crosscut 65 feet in, a branch of the vein goes into the foot-wall and splits into a number of stringers. The other branch is followed by the drift. It gradually narrows in approaching the face, where it strikes north 30 degrees east and dips 80 degrees northwest. This vein is assumed to be the continuation of the Goodenough vein, but even allowing for change in strike it would appear to be somewhat out of the true position for this vein. On its dip, too, the Goodenough vein should lie somewhat to the north of the exposure investigated by No. 5 adit and it may be that there is a fault somewhere between this exposure and that of the vein at No. 4 adit.

The position of the main ore shoots is indicated by the stope pattern on the section accompanying Figure 6. Stoping was in progress at the time of the writer's examination so that the stoped-out areas may not represent the extent of the ore-bodies. It will be noted, however, that the main stopes occur in the western mine workings and that very little ore has so far been taken from the eastern section. Where the ore shoots occur in this western part of the mine a few, narrow tongues of granodiorite are cut obliquely by the vein, but it cannot be said that the ore occurs only where the vein has granodiorite on one or both walls.

(14) Carthage Group

This group is on the eastern slope of the North fork of Wildhorse creek, about 1½ miles by trail, from the Ymir mine. Workings on the X-Ray claim were examined by the writer's assistants and consist of upwards of fifty cuts, a 50-foot adit, and a shallow incline shaft which was not examined. Five main veins are indicated on the property and, in addition, a number of segments of veins that cannot be related to the main veins.

The adit, elevation 4,425 feet, and one cut near it are the highest and most northeasterly workings. The adit has been driven northeasterly and exposes a vein striking north 40 degrees west and dipping 17 degrees southwest. At the portal the vein is about 10 feet thick and the back of the drift is in vein matter for about 30 feet to where the vein disappears. At 40 feet, a fault, striking north 55 degrees west and dipping 29 degrees northeast, offsets the vein down to the adit level, and from there it has been followed to the face, where it has a dip of 29 degrees. The vein conforms with the foliation of the Pend d'Oreille schist, consists of dark quartz with masses of milky quartz, and contains scattered pyrite and iron oxide. The pyrite occurs partly filling drusy cavities.

About 75 feet southeast of the adit portal the vein is exposed in an open-cut 15 feet long. Here, also, it conforms with the foliation of the schist and has the same strike and dip as given above, but is only 2 feet wide.

Two lines of open-cuts, fourteen in number and extending over a length of 475 feet, expose what are believed to be faulted segments of the same vein. The uppermost of the cuts is about 750 feet southwest of the adit. Eight cuts, about in line, expose a quartz vein 18 inches to 3 feet wide, striking north 40 to 50 degrees east, dipping 40 to 55 degrees to the southeast, and mineralized by pyrite and iron oxide. Between the fourth and fifth cuts, the southwesterly part of the vein is offset a few feet to the southeast of the line of strike. Below the sixth cut the vein is again moved over a few feet to the southeast. Cuts 9 to 14 are on a vein that lines up about 75 feet to the southeast of the line of strike of the vein as deduced from the upper cuts, and if these lower cuts expose the same vein there is a fault of considerable magnitude between the eighth and ninth cuts. The lower six cuts extend for nearly 300 feet and expose a vein that strikes from north 35 degrees east to north 50 degrees east and dips from 40 to 55 degrees to the southeast. The width varies from 3 to 4 feet and the mineralization is the same as in the veins previously described.

About 300 feet farther east is another vein exposed for 100 feet by a line of open-cuts. This vein strikes north 45 to 48 degrees east and dips from 38 to 60 degrees southeast. It is from $1\frac{1}{2}$ to $2\frac{1}{2}$ feet wide and is identical in mineralization with the veins previously described.

Two other cuts, from 50 to 75 feet east of the last mentioned vein, disclose veins about 15 feet apart and 4 feet wide striking north 45 degrees east and dipping vertically. Both show strong pyritization.

Another line of cuts, 200 feet west of the lower end of the line of open-cuts first described and extending over a length of 200 feet, exposes vein segments striking north 30 to 67 degrees east and dipping 55 to 70 degrees southeast. Vein widths cannot be exactly measured in many of these cuts but appear to vary from 1 to 4 feet.

A number of other cuts to the west and northeast disclose isolated vein exposures that cannot as yet be correlated.

(15) Roanoake Group

Reference: Drysdale, C. W.: Geol. Surv., Canada, Mem. 94, Ymir Mining Camp, pp. 73-74 (1917).

This group of fourteen claims and fractions extends from Wildhorse creek, near the Blackcock property, southwest towards the Two Star property. It is reported to be owned by A. J. Campbell, W. Roy Hunter, and associates.

The only showings seen were those bordering on Wildhorse creek. From these showings a wide bench extends to the valley wall. It is covered with glacial drift and, consequently, lacking in outcrops that might serve to relate other exposures of vein matter, said to have been seen much higher up the hill, with those along the creek. The rock formation in this part of the group consists of Pend d'Oreille schists close to a granodiorite mass in which the Blackcock and Wilcox deposits occur.

Several granitic dykes appear on the property. The mineral deposits are sulphide impregnations of pyrite and some galena and, apparently, follow certain beds or series of beds in the schists. So far as can be told from the exposures the deposits conform with the foliation of the schists. The workings are shallow cuts and two short adits at the edge of the creek. The adits are caved.

At one cut on the south side of the creek is 2½ feet of rusty-coloured schist impregnated with veinlets of quartz and with disseminated pyrite. The schist band strikes north 40 degrees east and dips steeply northwest. It is flanked on the west by 2 feet of schist carrying considerable quartz and pyrite and separated by 5 feet of drift from 2 feet of blocky argillite carrying disseminated pyrite and some galena. It is reported that five assays were taken across this entire zone and that these averaged \$7 a ton in gold. The 2 feet of blocky argillite is stated to have assayed \$9.50 in gold.

Some 30 to 40 feet upstream, that is easterly from this cut, is a strongly silicified zone in the schist carrying bunches of bluish quartz in a white quartz with white mica. A width of about 6 feet is exposed. It is reported that assays ranging up to \$15.50 a ton have been obtained here.

Across the creek and some distance to the east is an adit, now caved, which is reported to have followed a streak of ore running \$40 a ton. Material on the dump includes quartz, with fragments of country rock, and contains pyrite, zinc blende, and galena. A dyke of granitic rock, slightly altered and silicified, occurs a few feet to the east of the adit.

Within the next 70 feet downstream, or to the west, are several shear zones 3 to 5 feet wide and striking with the enclosing formation. These carry some quartz, but no sulphides. About 75 feet farther is another shear zone, 8 to 9 inches wide and mineralized with considerable pyrite. In the 3 feet of schist flanking this shear zone are numerous stringers of quartz striking in the same direction but, apparently, carrying no sulphides.

Several mineralized shear zones have been reported to occur on the hill slope to the south. They were not seen by the writer.

(16) Blackcock Group

References: Ann. Repts., Minister of Mines, B.C., 1928, pp. 332-333; 1932, p. 187; 1933, p. 227; 1934, p. E 13. Drysdale, C. W.: Geol. Surv., Canada, Mem. 94, Ymir Mining Camp, pp. 67-68 (1917).

This group, owned by A. McMillan, is on the northern side of Wild-horse creek to the southwest of the Wilcox property and about 5 miles, by road, from Ymir. It is being prospected by a Calgary syndicate and workings are all on the Blackcock claim.

A reference to the Blackcock is contained in Drysdale's report, but some confusion has, apparently, arisen with respect to the boundaries of the claim, for he describes the deposit as occurring in a roof pendant of Pend d'Oreille schist and as belonging to the general group of north-south veins, whereas the trend of the deposit is actually east-west and the country rock is the Nelson granodiorite. It is obvious, therefore, that this is not

the same deposit as that described by Drysdale. The roof pendant described by Drysdale lies to the west of the known vein on the Blackcock claim. The vein is of the fissure type, but the wall-rocks are silicified and mineralized for varying distances from the fissure and contain irregular masses and disseminations of galena, pyrite, and zinc blende. Principal values are in gold. The general strike of the vein is from east to south 70 degrees east and the dip from 60 to 75 degrees northerly. The vein has been traced at the surface for a length of about 670 feet and is explored by shafts and adits. The latter may be considered, in order, from west to east.

No. 1 shaft is about 215 feet above and 630 feet west of the main working adit, known as No. 8. The shaft was inaccessible but is reported to be 55 feet deep and to expose, just below the collar, 8 feet of iron-stained vein matter containing masses of pyrite with some galena and zinc blende. O'Grady (1928) gives the assay of a grab sample from the ore on the dump of this working as: gold, 0.48 ounce a ton; silver, 1.3 ounces a ton; lead, 2.3 per cent; and zinc, 3.1 per cent.

Seventy feet from this shaft is No. 2 working, an adit 25 feet long, driven northwesterly or diagonally across the vein. As exposed in the adit the vein has a width of $15\frac{1}{2}$ feet, but as the face of the adit has not reached the hanging-wall of the vein, it is impossible to state how wide the vein is. At the portal of the adit there is a narrow streak carrying considerable galena and zinc blende, but, apparently, not connected with the main vein. In the adit and extending to the face the granodiorite is considerably silicified and, in places, almost entirely replaced by quartz. Both the granodiorite and the quartz are impregnated with pyrite and carry a little galena and zinc blende. O'Grady (1928) gives the following assays from this working: across 5 feet at foot-wall—gold, 0.77 ounce a ton; silver, 2.6 ounces a ton; lead, 7.9 per cent; zinc, 4.9 per cent; next 30 inches—gold, 0.51 ounce a ton; silver, 0.5 ounce a ton; lead 1.4 per cent; zinc, 0.9 per cent; next 24 inches—gold, 0.26 ounce a ton; silver, 0.7 ounce a ton; lead, 1.1 per cent; zinc, 0.6 per cent; across 6 feet silicified granite on hanging-wall—gold, 0.27 ounce a ton; silver, 0.5 ounce a ton; lead and zinc not determined.

Immediately to the east of this working the vein is cut by a microlamprophyre dyke striking north 45 degrees west and standing vertically.

No. 3 working is a 40-foot crosscut adit and is about 100 feet east of No. 2 working. Where the crosscut intersects the vein a raise goes up to the surface and some stoping has been done. From the end of the crosscut a drift runs 50 feet to the west. The full width of the vein is not apparent in this working, the ledge matter being well-silicified and pyritized granodiorite.

About 100 feet farther east is the main shaft. This is about 100 feet deep and from it is a short drift west on the 25-foot level, short drifts east and west on the 50-foot level, and a short drift west on the 100-foot level. The bottom of the shaft was recently connected with No. 8 working below, by a raise. The shaft and drifts followed what was assumed to be the hanging-wall of the vein, but the raise from No. 8 following the same wall required an 8-foot crosscut towards the foot-wall to break into the bottom of the shaft. This crosscut is in silicified and pyritized granodiorite

overlying what was formerly taken to be the hanging-wall of the vein on the 100-foot level. In the drift on the 100-foot level the vein strikes east and dips 75 degrees to the north. The foot-wall is well defined, with striations plunging to the west at 60 degrees from the horizontal. The vein walls are about 5 feet apart, but mineralization extends beyond the hanging-wall. The vein material is silicified granodiorite carrying small streaks of pyrite, galena, and zinc blende. These are generally from $\frac{1}{4}$ to $\frac{1}{2}$ inch wide and lie parallel to the foot-wall of the deposit. The individual streaks are generally only a few inches long, but there are many of them. A specimen of silicified granodiorite was examined under the microscope. The rock is highly altered, but some individuals of quartz, orthoclase, and plagioclase may be recognized. Abundant sericite mica has formed along planes of cleavage between the other minerals and abundant secondary quartz was seen penetrating along the planes of cleavage in the rock.

At 165 and 205 feet easterly from the main shaft are two other shafts, now inaccessible. They were sunk on the vein.

About 420 feet easterly from the main shaft and about 165 feet below it is the main adit known as No. 8. It was driven northwesterly as a crosscut for 120 feet and follows a lamprophyre dyke. Failing to encounter the vein a crosscut was run 50 feet northeasterly through the dyke at about 30 feet from the face of the adit. This working also failed to pick up the vein. At 45 feet from the portal, a drive was started in a direction slightly south of west and carried 520 feet on this course, reaching a point almost vertically under the collar of the main shaft. From the face of this drive a crosscut was run slightly west of north and at 120 feet entered the vein. A short drift was run westerly on the vein and the raise, previously referred to, was put up to connect with the bottom of the shaft in order to drain it and to afford ventilation. The short drift is in silicified granodiorite and the vein has no defined walls. A streak of high-grade ore, 2 inches wide, and well mineralized with galena, pyrite, and zinc blende, appears in the face of this working. It was followed up by the raise, widened to 2 feet, and farther up split into a number of streaks before reaching the bottom of the shaft. In the drift the mineralized streak strikes east and dips 60 degrees to the north. Near the face of the long westerly drive previously referred to, from the crosscut adit is a fault striking parallel with the vein and dipping 60 degrees to the north. It carries 3 or 4 inches of gouge but is not mineralized. A second fault, striking north 20 degrees west and dipping 40 degrees southwest, shows in the drive about 75 feet from the face and also carries several inches of gouge along the fault plane. If the latter fault be assumed to be of the normal type, as is probable, the eastern section of the vein, which was not found by these workings, will have been moved to the north with respect to that section of the vein that has been found and this may explain why the crosscut from the portal failed to find the vein.

About 40 feet to the east of the portal of No. 8 adit and slightly higher in elevation is a small streak of galena, pyrite, and zinc blende in the granodiorite. This has no apparent connexion with the vein.

The mineralization appears to be the strongest towards the western end of the vein as now known, that is in the direction of the roof pendant

referred to above. Whether the mineralization dies out along the strike or whether the easterly extension of the vein has been shifted to the north with respect to the section of the vein now known, cannot be told from the workings. The vein should be followed to get under the strong showings indicated by present surface workings west of the adit workings, and further prospecting should be done in this direction at the surface. Prospecting should also be done to pick up the easterly extension of the vein beyond the fault.

(17) Wilcox Mine

References: Drysdale, C. W.: Geol. Surv., Canada Mem. 94, Ymir Mining Camp, pp. 75-89 (1917). Ann. Repts., Minister of Mines, B.C.: 1933, p. 226; 1934, p. E 13.

This property is on the north side of Wildhorse creek, and is accessible from Ymir by about 7 miles of a road that terminates at the mill about 800 feet below the mine. The mine is being worked by Messrs. J. J. Cullinane, D. H. Norcross, J. A. Cullinane, and Frank Moline under lease from the owners, the Ymir-Wilcox Development Company, of which W. H. Mason of Pasadena, California, is managing director.

The property is described in great detail by Drysdale and it is unnecessary to repeat more than the salient facts here as little development work has been done since the date of his report. The vein occurs in the Nelson granodiorite. It strikes south 80 degrees west and dips to the southeast at 65 to 70 degrees. The vein has an average width of about 18 inches and consists of silicified country rock with veinlets and irregular masses of pyrite, galena, and zinc blende. Values are principally in gold. The pyrite is stated to be auriferous, but the very high-grade ore is associated with galena.

The mine is opened by three main adits known, from the uppermost down, as Nos. 1, 2, and 3. In addition, a short level known as No. 2A has been driven to the west of No. 2. The other adits mentioned in Drysdale's report are caved. No. 1 adit is about 150 feet long and is a drift on the vein for most of this distance. At the portal the vein is 40 inches wide and about 30 feet from the portal the stope raise from No. 2 level enters the adit. Starting at 40 feet from the portal, the vein is stoped above the level nearly to the surface for a length of 55 feet. The stope varies in width from $2\frac{1}{2}$ to nearly 5 feet. About 100 feet from the portal the vein enters a zone of broken ground through which it apparently passes without offset, but it cannot be mined there on account of the broken nature of the ground.

Adit No. 2 is southeast of No. 1 and about 100 feet below it. It is a crosscut for about 465 feet to where it enters a fault zone. A crosscut from there picks up the faulted segment of the vein and drifts west along it, but there the vein has been stoped out from below. The eastern segment of the vein is followed about 400 feet to the contact of the granodiorite with a schist inclusion. Where the vein enters the schist, the ore spreads out along the contact in the form of a T and the vein in the schist is barren. In this drift an ore shoot about 100 feet long was encountered.

A winze connects No. 2 level with No. 3, 219 feet below. Above No. 2 level a raise connects with No. 1. In the winze a sub-level driven 145

feet below No. 2 level follows the vein for 60 feet to the west and 46 feet to the east of the winze.

No. 3 level is an adit driven on the vein for 375 feet with a short stope about 50 feet from the portal. The adit then cuts through barren rock for 546 feet to make connexion with the winze from No. 2 level. From the foot of the winze the vein has been drifted on easterly for 48 feet. The schist pendant encountered on the level above has not been found in these workings.

On the same level as No. 2 and about 120 feet northerly from it, a short drift, known as 2A, has been run easterly on the western segment of the vein beyond the fault. This leaves 250 to 300 feet of this section of the vein not drifted out on this level.

No ore was encountered above No. 3 level in the winze until the sub-level was reached. Here ore first appeared on the west side of the winze, but a raise had to be carried up another 50 feet to reach the bottom of the ore on the eastern side of the winze. The ore shoots rake towards the east.

No exploratory work is being done on the property, the lessees devoting their attention to extracting ore now developed. The ore mined is put through the old stamp mill, after a preliminary hand sorting, and the ore treated amounts to about 300 tons monthly. The mill is connected with No. 3 adit by means of an aerial tramway. The mill heads are stated to run from \$17 to \$25 a ton.

It is proposed, this winter, to develop, by a crosscut from the existing workings, a vein on the adjoining Arizona claim owned by D. E. Grobe. This vein is stated to have been traced on the surface for about 1,000 feet, running into the Wilcox claim at its upper end. The vein has been opened up at the surface for about 500 to 600 feet by cuts and short adits, now caved. It is stated to be about a foot wide, with assays running \$16 to \$18 a ton in gold.

(18) Tamarac King Solomon Group

References: Drysdale, C. W.: Geol. Surv., Canada, Mem. 94, Ymir Mining Camp, pp. 98-99 (1917). Ann. Repts., Minister of Mines, B.C.: 1928; 1932.

This group, owned by E. W. Widdowson of Nelson, was not examined by the writer as it was not known, at the time, that any recent work had been done. It is described in detail by Drysdale and the reports of the Minister of Mines for British Columbia. A private report on the property by S. J. Schofield and F. O. Orr was also loaned to the writer by the owner. These reports indicate a fair tonnage of ore in the old working.

The recent work is stated by Mr. Widdowson to be on a new vein northerly from the old workings. Some work was done on this in 1932 and is described by O'Grady as follows (1932, page 188).

"The present operators have largely confined their attention to the higher grade ore in the prospect shaft, the collar of which is situated about 125 feet northerly from the portal of the tunnel workings and approximately at the same elevation.

"This old shaft was not mentioned in previous reports, the opening being obscured by dense brush. It is sunk about 35 feet on the vein, which locally strikes north 5 degrees east and dips at from 30 to 50 degrees to the east. About 12 feet down short drifts extended to the north. Two carloads of ore were extracted from the upper level where the vein is from 3 to 4 feet wide containing oxidized and decomposed bands of ore from 1 to 2 feet wide. Quartz, occasionally containing visible gold, is found in spots, but the ledge filling is chiefly ironstained, decomposed, granitic rock. In the shaft below this level and in the lower drift, iron sulphides, said to contain fair values, make their appearances. Early in 1933 the first lot of about 22 tons was shipped.....the assay.....being as follows: gold, 0.515 ounce per ton; silver, 0.27 ounce per ton..... About 1,000 feet northerly from the prospect shaft 110 feet of crosscutting was done to test a surface showing on what is believed to be the same vein.....on the Pathfinder claim which has since been acquired by the Tamarac operators."

Mr. Widdowson states that at the bottom of the shaft a drift was run north 50 feet and, in the face, the vein was cut off by a dyke. On the surface the vein is reported to have been located beyond the dyke.

(19) Gold Cup

Reference: Drysdale, C. W.: Geol. Surv., Canada, Mem. 94, Ymir Mining Camp, p. 94 (1917).

This property, which comprises twenty claims and fractions, lies at an elevation of 5,000 feet on the western slope of Elise mountain about 2 miles northeast of Porto Rico siding on the Great Northern railway. A tractor road from the Nelson-Spokane highway, a short distance south of Porto Rico, affords access to the property. The group is being prospected by the Gold Cup Mining Company, Limited, of Nelson, B.C. Mr. R. W. Haggen is in charge of operations. Principal workings are on the Ohio No. 1 and the Gold Cup No. 3 claims.

The mineral deposits are close to the contact between a number of tongues of granite porphyry and rocks belonging to the Rossland Volcanic group. Both groups are sheared. Though much of the surface in the vicinity of the deposits is covered with drift it is believed that the granite porphyry occurs as a series of tongues cutting the members of the Rossland volcanics, rather than as a continuous mass. The volcanic rocks consist of agglomerate, augite porphyrite, and andesite.

The underground workings are on the Ohio No. 1 claim and consist of a shaft 106 feet deep and an adit level run to connect with the bottom of the shaft. A winze 65 feet deep has been sunk from the adit. Short sub-levels have been driven at various elevations from the shaft. The adit is driven 107 feet in a northeasterly direction where it encounters the south vein and thence 25 feet northerly to reach the main vein. The south vein has been drifted on easterly for 80 feet to where it is cut off by a fault beyond which the drift continues easterly for 25 feet. The main vein has been driven on westerly for 50 feet and easterly for 145 feet. The winze was sunk in the easterly drift 75 feet from the crosscut. This was

full of water at the time of the writer's visit. At 110 feet from the cross-cut, the drift reaches the bottom of the shaft.

In the drift the main vein strikes from about north 85 degrees east to south 75 degrees east and dips from 70 to 80 degrees to the south. It varies from a few inches to 5 feet wide and the fissure filling is almost entirely quartz. It cuts both granite porphyry and augite porphyrite and is a well-defined fissure-vein crosscutting the schistosity of these rocks. Sampling of the vein along this level is reported to have given almost negligible values in gold. In the winze the vein is reported to widen to about 6 feet and to contain some gold values. A short distance east of the point where the crosscut enters the main vein a fault striking south 15 degrees west and dipping 80 degrees northwest offsets the vein to the north for a distance of 5 feet. Between this fault and the winze the vein is at its widest (4 to 5 feet), but beyond the winze it tapers to a stringer. In the westerly drift the vein is 3 to 8 inches wide. Above the level in the shaft values are reported to first appear at a short sub-level about 56 feet below the surface and the quartz there shows considerable iron stain and a number of rusty streaks. On the next, short sub-level, 35 feet below the surface, the vein is 24 inches wide near the western end and 18 inches wide near the eastern end. It is reported that values from this point to the surface average \$45 a ton in gold and silver. At the surface and 6 feet north of the collar of the shaft is a vein 18 inches wide converging towards the east with the main vein. A sample from this is reported to have given 0.36 ounce in gold a ton and 9.24 ounces a ton in silver.

The south vein is a composite vein consisting of three parallel stringers of quartz varying along their strike from 1 to 3 inches wide, separated by about a foot of country rock, which carries seams of calcite crossing between the stringers. These stringers strike about south 80 degrees east and dip very nearly vertically. They are cut off by a fault striking south 60 degrees east and dipping nearly vertical.

Where sulphides occur in the veins, they consist of pyrite and chalcopryite, but they are rare in the underground workings. It is possible that the small ore shoot indicated by the values in the shaft has a rake to the east and that the adit level has not been driven far enough to tap its downward continuation.

About 1,400 feet northwest of the adit, another showing occurs on the Gold Cup No. 3 claim. There a band of volcanic agglomerate with an exposed width of 200 feet trends north 25 degrees east and is flanked, on the west, by augite porphyrite. The agglomerate is heavily sheared, the foliation following the trend of the band and dipping 70 degrees to the northwest. In this band a series of quartz exposures have been traced for 120 feet and, presumably, are segments of a vein cut by a series of small step faults. On one of these exposures an open-cut was being driven but had not fully exposed the vein zone. The trend of the latter appeared to conform with the direction of the schistosity. Some of the individual bodies of quartz in the vein zone follow the schistosity in strike but dip at a much flatter angle. About $6\frac{1}{2}$ feet of vein matter was exposed in the cut. It is comprised of 8 inches of quartz at the outer edge of the cut, followed by 3 feet of country rock containing bunches of quartz and calcite, and succeeded by about 3 feet of quartz. The quartz is full of

vugs, many of which contain iron oxide. The quartz is mineralized with pyrite, chalcopyrite, and specularite, and is stained with malachite. The vein zone is exposed again about 15 feet south of the open-cut and is apparently displaced 8 to 10 feet to the west of its line of strike, presumably by a small fault. To the north of the open-cut it again outcrops about 10 feet away and is apparently moved over to the east of its trend. A short distance farther north is another outcrop of quartz, 8 inches wide, and this again is moved to the east. About 100 feet north of this a single outcrop appears again slightly to the east of the trend of the deposit. About 100 feet west of the last occurrences, five small stringers of quartz appear in augite porphyry, considerably altered to epidote. The veinlets vary from 1 inch to 8 inches wide and all occur within a breadth of 50 feet, measured across their strike which is about north 80 degrees east to east and west. They are, apparently, barren of sulphides, but iron oxide was noted in places.

(20) Porto Rico

References: Drysdale, C. W.; Geol. Surv., Canada, Mem. 94, Ymir Mining Camp, pp. 128-137 (1917). Ann. Rept., Minister of Mines, B.C., 1922, p. 207.

This property comprises a group of five claims, owned by E. Wragge of Nelson. It lies at the head of Barrett creek about 7 miles by road from Porto Rico siding on the Great Northern railway.

The property has been described fully by Drysdale and as almost no work has been done on it since, and as some of the workings have caved, less information is now available than at that time. Only a brief description will, in consequence, be given here and the reader is referred to Drysdale's report for more complete details.

The property was worked in 1898-99 by the Canadian Pacific Exploration Company and yielded \$56,511 or about \$17.21 a ton of ore milled. It was worked under lease by G. H. Barnhardt in 1903 and yielded about \$16,000, representing a value of \$17 to \$18 a ton. The last work recorded was in 1915 when about \$1,000 worth of ore was recovered by Smith Curtis. Recently, the property has been worked by lessees, but the writer has no record of shipments.

The vein on this property is a quartz-filled fissure striking north 50 degrees east and dipping 42 to 45 degrees to the northwest. Associated rocks comprise augite porphyry and a sill of augite-feldspar porphyry and the productive part of the vein is in the latter. The vein averages 2 feet in width and is mineralized, chiefly, by pyrite with values mainly in gold. Free gold has been reported but was not seen by the writer.

The vein is developed by four adits and a number of open-cuts, extending in all about half a mile from the apex of the vein on the summit down the hill towards Barrett creek. A lower adit, known as No. 6, has also been driven but is reported to be off the vein. It had caved at the entrance and could not be examined. Of the other adits, No. 3 is the only one now readily accessible. No. 4 is caved at the portal and the vein has been stoped from No. 3 to the surface. The stope has been left open and prevented an examination of the remainder of the higher levels. No. 3 adit developed an ore shoot 450 feet long that has been stoped above the level. The hanging-wall of the vein in this section is a

fine-grained, cherty, augite kersantite dyke about a foot wide. The vein varied along the level from 1 foot to $3\frac{1}{2}$ feet wide. About 50 feet from the face it is lost in a sheared section of the country rock containing many seams of calcite, but appears to have deviated toward the hanging-wall side. About 330 feet from the portal a winze had been sunk by recent lessees but was full of water. It is reported to be 20 feet deep and to have discovered ore.

No. 4 level is reported to be off the vein but to have been driven parallel with it for 358 feet and to have followed small bunches and stringers of quartz and calcite for 90 feet. The level, it is reported, has not been driven far enough to get beneath the ore shoot stoped from No. 3 level.

The apex of the vein is exposed by open-cuts at the summit of the hill. The most southwesterly cut failed to locate the vein, but farther northeast and along its strike two other cuts expose the vein and there it is 2 and 3 feet wide, respectively. The vein exposed in these cuts was traced down the hill by outcrops and float to a point opposite the entrance to No. 1 level. Here it was found to be offset about 50 feet to the south of the vein exposed above the portal of No. 1 adit. A cross vein in No. 1 adit, just southwest of the stope opening referred to above, is reported to strike towards these outcrops but could not be seen on the surface. As the Porto Rico vein is reported to be lost towards the end of the upper workings, it is possible that the vein shown in the open-cuts is not this vein, but one *en échelon* with it and extending farther northwest. Only low gold values have been obtained from the open-cuts, but further surface prospecting should be done to prove the relations of the vein exposures there to the main vein as developed underground. The matter has a considerable bearing on the future of the property.

(21) Spotted Horse Claim

This claim is northeast of the Porto Rico group and is owned by E. Wragge of Nelson. The workings consist of one small open-cut and a short adit.

The country rock is augite porphyrite of the Rossland Volcanic group. The open-cut is a few hundred feet from the road to the Porto Rico camp at the side and near the head of one of the branches of Barrett creek. It exposes a quartz vein composed of two stringers of quartz separated by country rock. The stringers strike north 75 degrees east and dip at 65 and 55 degrees, respectively. At the top of the cut the northwest stringer is about 2 inches wide, but pinches towards the bottom of the cut which has a face about 5 feet high. The southeast stringer is 2 to 3 inches wide and at the bottom of the cut is a foot from the other stringer, whereas at the top of the cut the stringers are $2\frac{1}{2}$ feet apart. The country rock between the two stringers is slightly sheared. No sign of sulphide mineralization was seen.

The adit is in the bed of the same stream, immediately below the road, and is about 150 feet long. The deposit consists of a number of veinlets traversing the rock in a shear zone that has no definite walls. The general direction of the zone is south 70 degrees east and the dip is

55 to 60 degrees to the northeast. A quartz vein occurs at the portal and has this attitude. It is 6 inches wide and pinches out within a short distance in the adit; but, farther in, are a number of stringers running in different directions. Some are of quartz and others, particularly those running across the direction of the shear, are of calcite. The zone appears to be 3 to 4 feet wide, but the only definite wall appears at the face where a well-marked plane, with the attitude given above, forms the foot-wall of the shear zone. No sulphides were seen, but according to Mr. Wragge thin plates of native gold are found in the small stringers. It is reported that 17 tons were shipped from this working and averaged \$21 in gold.

(22) Fern Mine

Reference: Drysdale, C. W.: Geol. Surv., Canada, Mem. 94, Ymir Mining Camp, pp. 137-146 (1917).

This property is being developed by the Gold Fern Mines, Limited. It is on the south side of Hall creek about 3 miles from Hall siding on the Great Northern railway some 10 miles south of Nelson. A road connects the mine camp with the Nelson-Spokane highway, and a horse-drawn stone boat conveys supplies to the mine workings 900 feet above the camp.

The property was examined by Drysdale and his report should be read with the present one as some of the mine workings are caved and could not be re-examined. The Fern mine was staked in 1897 and was acquired the same year by the Fern Gold Mining and Milling Company. During the year development work was pushed and a ten-stamp mill was erected on Hall creek below the mine. Ore to the value of about \$40,000 is reported to have been produced. About 1900 the ore-body was lost, presumably through faulting, and the property closed down, but in 1902 the mine was leased and more ore opened up. Since that time the property has been operated at intervals, chiefly by lessees, but it is believed that the greater part of the work was done prior to 1915. The mill was destroyed in a fairly recent forest fire which swept most of Ymir district.

The surface, near the workings, is so drift-covered that outcrops are rare and widely scattered and as many of the old trenches have sloughed in it is difficult to trace the geological formations. Such observations, however, as may be made on the surface, coupled with the information afforded by the underground workings, show that the country rock of the vein deposits is an augite porphyrite referred to the Rossland Volcanic group. The rock is dark greenish grey with visible crystals of augite. In some places it is massive, in others schistose. Near the Fern vein and a few other points it is cut by granite porphyry which is generally highly altered and schistose, but in some places appeared massive and comparatively fresh.

The Fern deposit is a fissure vein between well-defined walls and varies in strike from north 55 degrees east to about north 75 degrees east. It dips to the northwest at about 60 degrees. The vein is slightly sinuous in strike and follows rather closely the dyke of granite porphyry referred to above. The vein is later than the granite porphyry, occurs on one side or the other, and at some points leaves the dyke altogether. The width of the vein varies from a few inches to 8 feet and high-grade streaks are

generally a few inches to about a foot wide. That part of the vein mined in the old stôpes seems to have varied from about 1 foot to 3 or 4 feet wide, but at some points it is difficult to tell how much waste was broken with the ore. The vein is composed partly of quartz and partly of crushed country rock, the relative amounts varying greatly from place to place. Pyrite is the chief metallic mineral. Chalcopyrite is reported from some of the workings and was observed from some of the other veins on the property, but was not seen by the writer in the underground workings on the Fern vein itself. Free gold also occurs. It was not observed by the writer in the underground workings but is quite common at the surface in small veinlets, occurring as offshoots of the main vein. Visible gold is quite plentiful in the oxidized material and small amounts of the latter were being sacked for shipment. A sample of some of it is stated to have assayed 21.60 ounces in gold a ton. The paying portions of the vein occur as ore shoots and the main shoot appears to lie northeast of the main fault of the mine. A second shoot is indicated by some stoping below the shaft (See Figure 7). Drysdale states that the productive portions of the vein are those in contact with the granite porphyry dyke.

The Fern vein is cut off to the southwest by a major fault striking northwest and dipping 75 degrees northeast. Injected along this fault is a lamprophyre dyke. The vein has not been found beyond the fault and there is some doubt as to whether this is a pre-mineral fault, with the vein and ore shoot terminating against it, or a post-mineral fault which has displaced the vein for a considerable distance. No drag ore appears along the fault nor could the writer find evidence that mineralization followed the fault plane. There is no evidence to indicate whether the faulted segment lies to the southeast or to the northwest. It may be stated, too, that F. A. Thompson, of Washington State College, did considerable work in search of the vein beyond the fault and favoured the view that the fault was pre-mineral and that the vein turned and followed it for a considerable distance in a pinched condition.¹ At other properties in the district, however, these northwesterly faults have been proved to be post-mineral and of the normal type.

The mine workings are shown in Figure 7. Levels 1 and 2 are inaccessible. Level No. 3 is a crosscut adit which encounters the vein at 80 feet and continues past it for 100 feet. From the point of intersection a drift has been run following the vein southwest for about 400 feet to where the fault mentioned above was encountered. A crosscut was driven in the plane of the fault northwest for 75 feet and the main drift was then continued through the fault plane and gradually turned to the southeast as a crosscut. Near the face this working enters a granite porphyry dyke which, however, is believed to be a different dyke from that accompanying the vein as it is much less altered.

Level No. 4 is a crosscut adit 150 feet below No. 3. The crosscut is 220 feet long; at 120 feet there are short crosscuts to both sides of the adit and at 190 feet a drift to the southwest enters the main vein and follows it for 500 feet to the fault. Where this drift intersects the vein a branch vein goes off into the hanging-wall. The main crosscut also inter-

¹ Drysdale, C. W.: Geol. Surv., Canada, Mem. 94, Ymir Mining Camp, p. 146, footnote (1917).

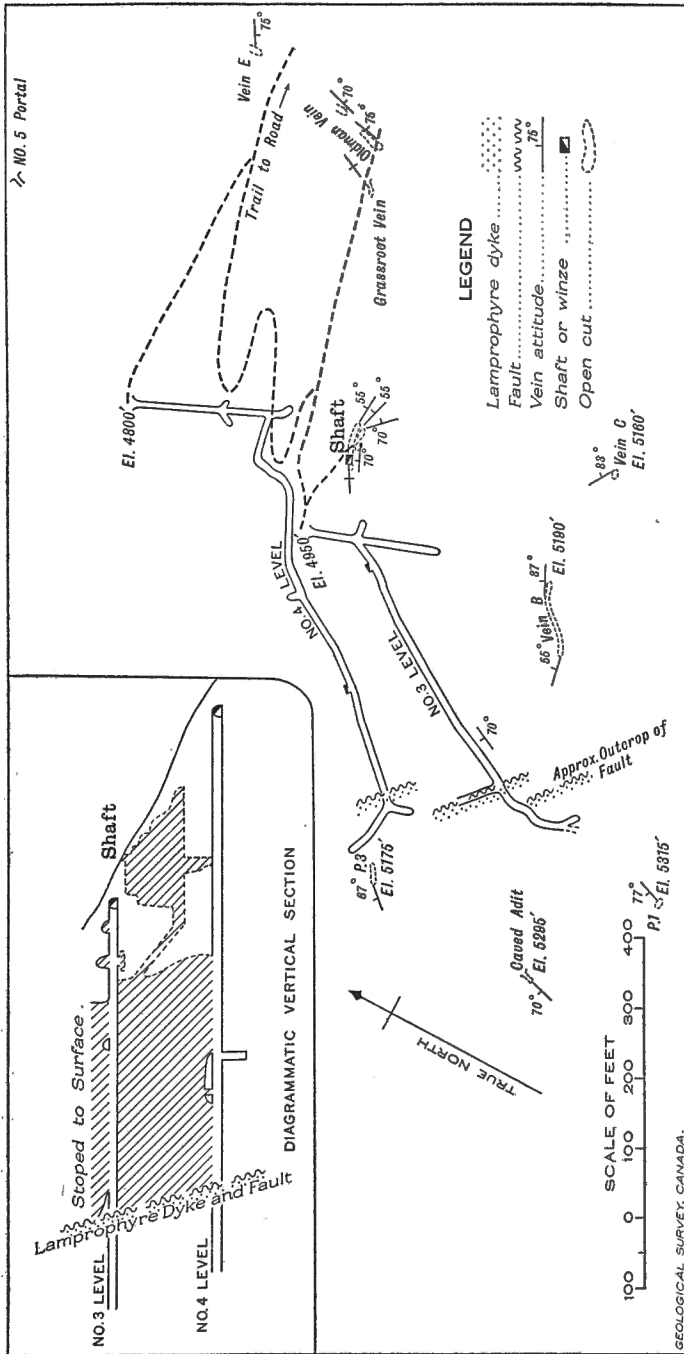


Figure 7. Fern mine, Ymir-Nelson area, Kootenay district, British Columbia; plan and section showing workings.

sects the vein and is connected by a stope to the bottom of a shaft. Part of the drift following the vein shows relatively little quartz, but the vein apparently widens out and becomes an ore shoot at about 300 feet from the fault. The second ore shoot, as mentioned before, is below the shaft. A winze is sunk from a point in the main drift about 170 feet northeast of the fault. Beyond the fault one crosscut was run 80 feet northwest and another 30 feet southeast, but the granite porphyry dyke of the level above was not encountered.

More recently, a level was started near the creek about 900 feet below No. 4 adit, but was abandoned for the reason that it involved a long drive to the vein and because the position of the vein at that elevation was uncertain. A level, known as No. 5, was also started 150 feet below No. 4, but at the time of the writer's visit had been driven only a few feet.

The vein at the shaft is undoubtedly the main Fern vein. Here it is 2 feet wide and is composed, mainly, of quartz well mineralized with pyrite. A number of stringers split off from it and their strikes and dips are shown on Figure 7. These stringers have a maximum width of about 2 inches and are exposed for only a short distance along their strike. High-grade, oxidized material, containing much free gold, was being sacked at this point. Good values are also reported from the main vein at the shaft, but this vein is stoped to near the surface.

A number of other veins appear on the property. Some seem of minor importance as compared with the Fern vein; others are, however, worth further exploration. The location of these veins is shown on Figure 7.

Vein E is about 200 feet northerly from the Oldman and Grassroot veins and is exposed by a surface cut near the trail to the Fern workings. In the face of the cut, which is about 8 feet high, the vein, at the top, is 18 inches wide, but pinches to 2 inches near the bottom. More quartz appears in the floor of the cut, suggesting that the vein is again widening. The vein strikes about north 80 degrees east and dips about 75 degrees to the southwest or in the opposite direction to the Fern vein. Some limonite in the quartz is the only sign of mineralization. A general sample taken by Mr. McKechnie, engineer in charge, showed no values.

The Oldman vein is about 550 feet easterly from No. 3 adit portal and is exposed by three open-cuts. In the lowest the vein is not exposed. In the middle cut the vein-fissure is about a foot wide and, in some places, is entirely filled with quartz. In other places it is filled partly with quartz and partly with crushed country rock. Considerable pyrite appears in the vein matter. The vein strikes north 10 degrees east and dips 70 to 75 degrees to the southeast. To the south it is poorly shown in another cut where it consists of angular fragments of country rock cemented with quartz carrying coarsely crystalline pyrite. Four samples taken from these pits gave maximum values of 0.01 ounce of gold a ton.

The Grassroot vein lies 50 feet west of the Oldman vein and is explored by an adit. Owing to the condition of the timbering and the back of the adit it was considered unsafe to examine this working. The deposit is a composite vein consisting of three, small, nearly parallel quartz stringers in width 6 feet and separated by country rock. The central stringer has a maximum width of 6 inches and the other two of 4 inches. Their strike is

approximately north 30 degrees east and the dip about vertical. A sample of the quartz showed no values.

Vein B is approximately parallel with the Fern vein and is about 150 feet southeast of it. It has been stripped for 110 feet. Near the lower end of the cut the vein strikes north 65 degrees east, dips 87 degrees northwest, and consists of rusty quartz 10 to 14 inches wide. It gradually widens along the cut to a maximum of 20 inches and narrows again at the top of the cut to 4 inches. At the latter point it strikes 80 degrees east and dips 55 degrees northwest. The quartz contains some coarsely crystalline pyrite, and, in places, finely disseminated pyrite and a little chalcopyrite. Four samples taken by the company along the cut gave values of: 0.12, 0.16, 0.08, and 0.28 ounce of gold a ton, respectively.

Vein C is about 420 feet southeasterly from No. 3 adit portal, at the contact of a dyke of granite porphyry which cuts augite porphyrite. The strike and dip of the vein are irregular, but, perhaps, average about north 55 degrees west and 80 degrees northeast. The vein varies considerably in width, with a maximum of 18 inches, and appears to consist, in part, of silicified granite porphyry now partly converted to quartz but still showing phenocrysts of feldspar. Stringers of pyrite and stains of iron oxide are the only signs of sulphides.

Vein P 1 is some 700 feet southerly from No. 3 adit portal, and is a narrow stringer in augite porphyrite and carries pyrite, chalcopyrite, and malachite. Adjacent to the stringer the wall-rock carries the same minerals. The stringer strikes north 20 degrees east and dips 77 degrees to the northwest. A sample across 3 inches gave 0.24 ounce in gold a ton.

Vein P 2 is about 800 feet southwest from P 1. It strikes north 20 degrees east and dips at 27 degrees northwest. The vein is 14 inches wide and is composed of shattered rock cemented with quartz which shows many vugs lined with crystals of quartz and calcite. A grab sample of broken material gave 0.24 ounce of gold a ton.

Vein P 3 is 400 feet or so northeast of P 1. It is exposed in a cut for about 30 feet and strikes north 45 degrees east and dips at 67 degrees northwest. It has a maximum width of $4\frac{1}{2}$ feet near the lower end of the cut, but tapers to 2 feet near the top where it is cut off by a fault striking north 40 degrees west and dipping 77 degrees northeast. The vein shows very little sulphide.

(23) Three Friends Group

This property, consisting of nine claims held by location and the Alice Crown-granted claim, is on the south side of Hall creek. The Alice adjoins the claims of the Fern mine on the east and the Three Friends No. 1 claim is crossed by the Fern road about three-quarters of a mile from the Nelson-Ymir highway. The Alice claim is thus about a mile northwest of the Three Friends No. 1. These are the only claims of the group on which any exploratory work has been done. The other claims extend four claims' lengths up the south side of Hall creek from the Nelson-Ymir road. The property was examined by the writer's assistants.

Workings on the Alice claim consist of a 50-foot adit with a 40-foot winze, full of water at 15 feet from the portal. The adit is about 150

feet west of the centre of the eastern boundary of the claim. An open-cut is located about 250 feet from the adit in the direction north 80 degrees west.

The country rock at the open-cut is augite porphyrite. It is intersected by a quartz vein, about a foot wide, striking north 80 degrees west and dipping steeply to the south. The vein is mineralized by tetrahedrite and malachite with lesser amounts of chalcopyrite and pyrite.

The vein exposed in the adit is similar and is apparently the same as that in the open-cut, and has the same strike. It may thus be said to be traced for 250 feet. The adit follows the vein for about 18 feet to where it is lost. The vein is about 10 inches wide as far as the winze where it widens to 4 feet but is reported to pinch again in depth. No assay returns were available. From one of the owners, however, the writer obtained the information that high values in gold are obtained in places, but that values were characteristically spotty.

The workings on the Three Friends No. 1 claim are three-quarters of a mile from the Nelson-Ymir road, between the Fern road and Hall creek. They comprise a 50-foot adit with a 20-foot winze at 40 feet from the portal and three cuts, all near the adit and all showing parallel veins. The vein outcrop above the adit was stripped for about 10 feet. There are also small cuts on either side of the adit. One of these is above and on the south side of the adit and about 30 feet from it. The other is 60 feet north of the adit. These cuts show a little disseminated malachite.

The vein in the adit is of quartz, is about a foot wide, and is fairly heavily mineralized with tetrahedrite and malachite. It can be traced throughout the length of the adit between augite porphyrite on the hanging-wall, and schist on the foot-wall, side. The formational strike is approximately east and from the portal to the winze the vein follows this and dips about 80 degrees south. In the winze the vein turns to strike north 40 degrees east and cuts across the schist at the face of the adit. At the winze, too, the vein splits around a horse of rock about 8 feet wide. The two branches re-unite at the face of the drift. The small cuts on either side of the portal expose parallel sparsely mineralized veins.

(24) Gold King Group

The Gold King Group of nine claims, owned by J. E. Fisher of Hall and associates, is on both sides of Hall creek and adjoins the property of the Fern mine on the west and north. The road up Hall creek to the Fern mine continues to the Gold King cabin.

The country rock consists of andesites and augite porphyrites of the Rossland Volcanic group. In places these rocks are severely sheared and in others quite massive. The mineral showings consist of quartz veins and shear zones carrying veinlets of quartz, with pyrite the chief ore mineral; in places copper minerals also occur and free gold is reported, by Mr. Fisher, to have been obtained from some of the showings. In general the mineral showings are isolated exposures and insufficient work has been done to trace the continuity of the various deposits. The workings on the main vein, on the Gold King claim, were inaccessible at the time of the writer's visit.

The Gold King vein is exposed in a cut just below the cabin in the south bank of Hall creek. The elevation of the creek at this point is about 3,850 feet. The lead consists of a shear zone 17 inches wide, with about 6 inches of sparsely mineralized quartz on the hanging-wall. It strikes north 30 degrees east and dips 80 degrees to the northwest. Just across the creek a shaft has been sunk on the vein and a drift run for 50 feet southwesterly back under the creek from the bottom. These workings were inaccessible. A little north of the shaft an adit, 50 feet long, has been driven into the hill, northeasterly on a narrow shear zone containing 4 inches of mixed quartz and sheared country rock; the quartz is rusty, but otherwise there is little evidence of sulphide. Towards the face the quartz appears to be dissipated along joint planes in the country rock rather than confined to the shear zone.

About 500 to 600 feet along the strike of this vein zone four open-cuts expose narrow quartz veins in what has been assumed to be a continuation of the same zone. The area intervening between these and the Gold King workings is heavily drift covered. From the attitudes of the veins in these cuts it is apparent that they are small gash veins in the volcanics and it is doubtful if they are the continuation of the Gold King vein zone.

About 500 feet northerly from the shaft another adit has been driven 65 feet on a narrow shear which is nearly parallel to the Gold King vein. The shear strikes north 40 degrees east and dips 80 degrees to the northwest. It is 3 to 4 inches wide and, in places, carries quartz stringers; in other places there is little or no quartz. Both the quartz and the sheared country rock are well mineralized with pyrite. Values up to \$15.40 a ton in gold across 4 inches are reported to have been obtained from this working. About 50 feet above the adit and, possibly, 60 feet horizontally from it along the strike of the shear, a bunch of quartz $3\frac{1}{2}$ feet wide and about 10 feet long appears in a cut. Three feet from this, on the foot-wall side of the cut, is an 8-inch vein of quartz and at a similar distance on the hanging-wall, a narrow stringer of quartz from which Mr. Fisher states he has obtained free gold.

Two other small stringers occur at 10 and 20 feet east of this showing. These average a couple of inches wide, strike about north, and dip almost vertically. They carry pyrite and some malachite. A cut 15 feet north of the large quartz bunch shows a quartz vein striking north and dipping about vertically. It is 4 to 6 inches wide at the outer edge of the cut, but at the face a few feet away its width is only 2 inches. The quartz is full of drusy cavities filled with limonite and manganese oxide.

About 100 feet up the hill and slightly to the west of the last showing is a quartz vein striking north 10 degrees east and dipping very nearly vertically. This varies from 1 foot to 18 inches wide. A few feet up the hill a short adit has been driven on this vein which there shows the same characteristics but is slightly wider, averaging about 2 feet. A few feet higher, quartz float, heavily impregnated with pyrite, occurs, but its source has not been located.

About 750 feet above the creek and northwest of the showings previously described a quartz vein about a foot wide, striking north 30 degrees east and dipping 60 to 70 degrees southwest, is exposed on a small

bluff. Specularite, tetrahedrite, and malachite are scattered through the quartz. The vein is exposed for about 15 feet. No sampling has been done.

About 1,000 feet above the creek and some 500 feet west of the last showing a shear zone is poorly exposed in a large cut. The direction of the shear is probably northeast and the dip southwest, but this cannot be told with certainty from the exposure. The zone is about 15 feet wide. Several bunches of quartz appear in the cut; one on the north side appears to cut across the shearing and one on the south side seems to follow it. Pyrite, limonite, and manganese oxide appear both in the quartz and the sheared rock. Mr. Fisher reports that he has obtained specimens of free gold from this showing.

About 400 feet above and some 450 feet northeasterly from the Gold King shaft, a short adit has been driven on a shear zone striking north 40 degrees east and dipping southwest at 80 degrees. The zone is about 18 inches wide and carries stringers and bunches of quartz in the sheared country rock. Along the hanging-wall there is a heavily pyritized streak about 1 inch wide. This has not been sampled.

(25) Euphrates Group

References: Ann. Repts., Minister of Mines, B.C.: 1926, pp. 282-283; 1927, p. 319; 1928, p. 325; 1929, pp. 347-349; 1930, p. 267; 1933, pp. 223-224.

The Euphrates group, consisting of nineteen claims and fractions, is situated on the eastern side of Salmo valley about 10 miles south of Nelson and is owned by the Euphrates Mining Company, Limited, of Nelson. The claims are staked along a line trending northeast and cover an area roughly 9,000 feet long by 3,000 feet wide.

The rocks in the vicinity consist of chloritic schists of the Rossland Volcanic group which is composed of metamorphosed andesites, tuffs, and coarse-grained augite porphyrites. The series is intensely schistose, the foliation striking north 40 degrees west and dipping 70 to 80 degrees to the southwest. The deposits appear, in general, to be lenses, bunches, and stringers of quartz mineralized with pyrite, chalcopyrite, galena, zinc blende, and, in some instances, arsenopyrite in poorly defined shear zones. Free gold appears at numerous places in the oxidized material exposed by open-cuts, and is probably a local enrichment due to the oxidation and leaching of the vein material. The shear zones are mostly conformable with the schists, but one narrow, persistent, quartz vein crosscuts the foliation in dip.

The workings, some of which are caved, consist of one long adit, a number of short adits, a shaft, and a large number of open-cuts.

Most of the work has been done on the Ell Tee vein, a narrow but definite fissure vein, traceable at the surface for about 500 feet and carrying, in places, high gold values. It strikes north 40 to 45 degrees west in line with the foliation of the enclosing schists, but dips 70 degrees to the northeast or opposite to the direction of dip of the foliation. The upper workings on this vein consist of an open-cut, about 100 feet long, in which the vein cannot now be seen but is reported to have varied from 6

to 18 inches wide. Eighty-five tons of ore was reported to have been taken from this working and to have averaged \$100 a ton. An upper adit and shaft on this vein are inaccessible, but the former is reported to be about 175 feet long and to gain a depth of 30 feet at the face (1928; 1929). An ore shoot lying between 105 and 127 feet from the portal gave, according to assays quoted in this report, an average of 3.77 ounces of gold and 1.5 ounces of silver a ton over an average width of $4\frac{1}{2}$ inches.

About 210 feet below this level a lower adit has been driven on the vein for nearly 2,000 feet. From it crosscuts have been driven to explore the Minto and Lost Cabin veins, described later. Throughout this working the main vein is narrow, varying from less than an inch up to a foot wide and, as the wider parts of the vein are quite short, probably averaging 3 to 4 inches. It is composed of quartz carrying pyrite, chalcopyrite, galena, and zinc blende. Free gold is reported but was not observed by the writer. It is understood that in view of the width of the vein the values are, in general, too low to afford commercial ore over mining widths. Five assays (1929) from the outer part of this adit will give an idea of the content of the ore. These are as follows: 1, width 3 inches—gold, 0.98 ounce a ton; 2, width 9 inches—gold, 0.84 ounce a ton; 3, width 5 inches—gold, 0.59 ounce a ton; 4, width 18 inches—gold, 0.04 ounce a ton; 5, width 3 inches—gold, 0.17 ounce a ton. This lower adit has been driven well beyond the point at which the ore shoot found in the upper level and surface working occurred.

The Lost Cabin vein is roughly parallel to the Ell Tee vein and, if projected to a point opposite the latter, about 500 feet from it. The surface showings are, however, about 2,000 feet southeast from the Ell Tee adit and 560 to 1,000 feet higher. The lowest working is an open-cut showing an indefinite shear zone about 26 feet wide. The zone strikes north 25 degrees west and dips 65 degrees to the southwest. It contains several veinlets of quartz, about 1 to 4 inches wide, striking and dipping with the foliation of the enclosing schists. The quartz and schists are heavily iron-stained and the latter are, in part, altered to ankerite. No unaltered sulphides were seen in the cut, but Mr. Terzian, the chief owner, reports that both galena and zinc blende were encountered in making the cut and that values across the 26 feet averaged \$2.80 in gold and silver.

The next cut on this vein zone is about 150 feet higher and is about 50 feet long. Here the shear is about 8 feet wide and consists of broken and decomposed country rock traversed by veinlets of quartz which follow the shear. A few, small, reticulating veinlets dip across the shear at low angles. The quartz carries some unoxidized pyrite and chalcopyrite, but much of the original sulphide content has, apparently, been leached to iron oxide. Mr. Terzian reports that values of \$18 in gold and silver have been obtained here across a width of 8 feet.

At about 150 to 200 feet from the last cut an incline shaft, 20 to 25 feet deep, has been sunk on the zone which is about 15 feet wide and similar to the other exposures. It consists of decomposed country rock with quartz stringers, most of which parallel the shear. Some, however, cut flatly across the schistosity in dip. This exposure shows considerable

galena and zinc blende in the quartz and the gossan contains some cerussite. Mr. Terzian claims assays of \$18 a ton from numerous points in these workings. Samples quoted (1929) are as follows: width 3 feet—gold, 0.81 ounce, silver, 3.1 ounces a ton; width 22 inches—gold, 0.62 ounce, silver, 3.1 ounces a ton; width 10 inches—gold, 0.04 ounce, silver, 3.3 ounces a ton; picked sulphides—gold, 0.26 ounce a ton, silver, 35.3 ounces a ton.

Between the incline shaft and the cut last mentioned is a short adit, now caved. Extending along the zone beyond the shaft are other open-cuts tracing the zone southeasterly for about 900 feet. These were not examined by the writer.

In the long Ell Tee adit a crosscut and drift have been run from a point near the face to pick up this shear zone. This has a length of 300 feet and at 80 feet from the Ell Tee vein cuts an indefinite shear zone which is then driven on southeast for about 60 feet. The adit continues in this direction for 160 feet farther, but the zone seems to die out or is lost going southeast. No definite walls could be found, but the zone contains stringers of quartz carrying arsenopyrite and galena and a fair percentage of these sulphides also occur in the country rock. The schistosity at this point strikes north 60 degrees west and dips 60 degrees southwest. It is stated that values ran \$3.50 a ton across a width of 11 feet. Without an accurate map of the workings on the property it is difficult to know whether this is an extension of the Lost Cabin vein zone or not. In this Ell Tee crosscut it appears to be too close to the Ell Tee vein, but as the two are inclined towards one another their positions at this level can be calculated only from accurate surveys.

The Nickel Plate vein is a recent discovery. It is exposed on the Nickel Plate No. 1 claim, the lowest cut being about 2,000 feet easterly from the Ell Tee adit and about 1,100 feet above it. The workings include a chain of cuts exposing a vein zone for about 700 feet. In most of these the vein zone is only partly exposed, but is similar in character to the surface showings of the Lost Cabin vein and contains stringers of quartz striking and dipping with the foliation of the schist. Limonite in considerable amount is associated with masses of pyrite and arsenopyrite and at several showings free gold occurs in the gossan. In most of the cuts the quartz veins occur in a gossan which, on panning, shows considerable free gold. As far as can be determined from the open-cuts the zone is about 7 to 10 feet wide. In the lowest cut Mr. Terzian states he got \$7 a ton across 8 feet and in the next cut \$32.40 across 6 feet. The free gold is, apparently, a secondary surface enrichment. The vein zone is about parallel with, and 500 feet from, the Lost Cabin zone. Diamond drilling from the Lost Cabin workings in the Ell Tee adit, previously referred to, cut a zone 13 feet wide at 520 feet. This is believed to be the northwesterly extension of the Nickel Plate zone and the part intersected by the drill would lie about 1,200 feet northwest of the lowest, or most northwesterly, cut on the zone. It is reported that, where drilled, the vein zone gave values in gold and silver of \$3.75 across the 13 feet.

About 700 feet northerly from the main Ell Tee adit and at approximately the same elevation a short adit has been driven on the Minto vein. This is a zone 10 to 15 feet wide and consists of alternating bands of quartz and schist. One well-defined lens of quartz, 1 to 2½ feet wide,

strikes northwesterly with the formation, but dips southwest at 30 degrees. It is followed by the adit but gradually pinches. The foliation is here dipping northeast and numerous stringers of quartz dip with the foliation and towards this main lens of quartz. The zone is mineralized by pyrite, arsenopyrite, galena, zinc blende, and malachite. Three carloads of ore are reported to have been shipped from this working and are stated to have yielded \$21 a ton in gold and silver. From the Ell Tee tunnel, at 1,100 feet from the portal, a crosscut, 240 feet long, was driven to the northeast to pick up the extension of the Minto vein. This work was, apparently, not continued far enough to reach its objective.

(26) Golden Age

References: Ann. Repts., Minister of Mines, B.C.: 1922, p. 208; 1928, pp. 324-325; 1929, p. 346.

This property, consisting of nine claims, is owned by the Golden Age Mining Company, Limited, of Nelson, in which E. and S. Terzian are reported to hold a controlling interest. It lies on the western side of Salmo valley about 10 miles south of Nelson. The workings are quite close to the Nelson-Salmo highway, one adit being just to the side of the road. The lowest adit is a short distance below the road and the upper adit 100 to 125 feet above it. The Great Northern railway passes within 100 yards of the lowest level.

The lower slopes of the hillside are extensively drift-covered, but outcrops show that the underlying formations are schists of the Rossland Volcanic group. Near the deposits these are cut by several, fine-grained, dark grey to green, narrow dykes. A specimen of one of these dykes, examined under the microscope, showed phenocrysts of the augite in a fine-grained groundmass containing some augite and feldspar. The rock is an augite kersantite and is very similar in appearance and composition to the dyke accompanying the Porto Rico vein. The dyke rocks are unshaped, whereas the members of the Rossland Volcanic group are highly schistose. The deposit consists of one or more, poorly defined shear zones carrying stringers and bunches of quartz. Apparently these zones conform to the foliation of the surrounding rocks, striking north 30 to 50 degrees west and dipping 60 to 80 degrees southwest. They are mineralized with pyrite, chalcopyrite, galena, and zinc blende, these sulphides occurring, mostly, in the quartz. Values are principally in gold and are generally highest where there is considerable quartz and sulphides. Mr. Terzian was, however, able to point to places in the workings where values were obtained from the sheared country rock in which little quartz could be seen. The walls of the zones are indefinite, but mineralization is, in general, reported to occur across widths of 1 foot or less to 4 or 5 feet. In places the narrow dykes mentioned above form well-defined walls to the deposits.

The lowest adit is 50 to 60 feet below the road. It is driven 130 feet in a northwesterly direction and includes a short crosscut southwest about 20 feet from the face. This working apparently crosscuts a zone, containing some quartz, at an acute angle. A dyke, about a foot wide, occurs on the westerly side of the adit at the face and disappears in the opposite wall of the adit about 40 feet from the face. A second dyke, also about a foot

wide, appears on the western wall of the level about half-way between the portal and the face, but pinches out in a short distance towards the southeast. The rock on the eastern side of the first dyke is heavily sheared, but contains no quartz or sulphides. The crosscut, which penetrates through the dyke, discloses a narrow band of ore on its western side. Other small bunches of quartz and sulphide mineralization appear along the level, but no continuous zone can be defined, and it is by no means certain that the working is on the same zone as that exposed by the upper levels.

The middle adit, at the level of the road, is about 100 feet northwest of the lower adit and is about 800 feet long. It is a drift on the shear zone which strikes north 50 degrees west and varies from about 10 inches to 5 feet wide. A dyke forms the hanging-wall of the deposit for about 500 feet to where it apparently pinches. About 350 feet from the portal a crosscut has been driven southwest for 60 feet. At 565 feet from the portal a fault strikes north 60 degrees west and dips 15 degrees southwest, but the offset cannot be measured. The deposit ends southeast of the fault, and appears again about 115 feet past it. Several ore shoots are reported to occur along the adit. One shoot is stated to lie northwest of the fault, to be 150 feet long, and to end near the face. It is claimed that values in this section average \$12 a ton over widths ranging from 2½ to 4 feet. A good deal of quartz, mostly as stringers, running in the direction of the shear zone, appears along this section of the zone. Both this quartz and the country rock carry pyrite and chalcopyrite. Just above the fault values are stated to run \$9 a ton across a width of 4 feet; the zone has here practically no quartz in it. Near the crosscut a length of 50 feet of ore is reported, with assays of \$18 across 10 inches. Near the portal another 50 feet of ore is reported. The shear zone is there 5 feet wide and contains masses of rusty quartz in decomposed and oxidized schist.

The upper adit is about 250 feet, northwesterly, from the intermediate level and 100 to 125 feet higher. This adit is about 210 feet long. It is driven along the shear zone with two short crosscuts, one 15 feet to the northeast and situated about 25 feet from the face and the other 6 feet to the southwest and about 70 feet from the face. The zone is here somewhat similar to that in the middle adit, with bunches and stringers of quartz across a width of 2 to 4 feet. As in the middle adit, several short shoots of ore are reported.

A small stamp mill was built on the property, but was destroyed by fire in 1929. It is stated in the reports of the Minister of Mines, British Columbia, that very little ore from this property was put through the mill.

(27) Apex Group

This group is on the west side of Roaring creek about a mile northeast of Apex station which is about 6 miles south of Nelson on the Great Northern railway. It was being prospected by J. F. Coats. The group consists of eight claims owned by Messrs. Frank, Joe, and John Ogenski, and George Benwell, jun.

The deposit occurs in rocks of the Pend d'Oreille group, fairly close to the contact with the Rossland Volcanic group. Nelson granodiorite occurs¹ some distance north of the property.

The principal workings are on the Mystery and Horseshoe No. 1 claims and consist of a short adit, driven near the creek, and fifteen open-cuts. Fourteen of the latter are put in at intervals along the strike of the deposit, or a total distance of 1,200 feet northerly from the portal of the adit. Intervals between cuts range from 50 to about 160 feet and the difference in elevation between the adit and the uppermost cut is about 650 feet. One cut is between the adit and Roaring creek, on the bank of the creek.

The adit is driven into the face of a small bluff about 50 feet above the level of the creek. There the formation is Pend d'Oreille schist striking north 25 degrees west and dipping 83 degrees southwest. At the top of the bluff is a vein of quartz about 5 feet wide but tapering rapidly as the back of the portal of the adit is reached. The vein follows, fairly closely, the foliation of the schists. Underlying the vein is 6 feet or so of schist containing bunches of quartz and below this a second vein of quartz, narrow at the top of the bluff but widening to 4 feet at the adit level, which also parallels the foliation of the rocks. To the east of this quartz band is a narrow band of schist, followed by a dyke, 16 inches wide, of fine-grained, greenish grey rock similar to that on the Porto Rico property. The adit follows the vein for 15 feet; then swings to crosscut the dyke; then follows the dyke for 30 feet and again crosscuts it to enter the vein; and finally, follows the vein for 20 feet to the face. Twenty feet back from the face a crosscut has been driven to the west for 15 feet. Where quartz is visible in the adit it varies from 18 inches to about 3 feet wide and is irregular in that it sends out tongues into the schist. The quartz carries thin seams of black gouge which, apparently, are unreplaced remnants of the country rock and carry abundant pyrite. The quartz and also the dyke carry some pyrite. The deposit is a shear zone with indefinite walls 10 to 15 feet wide, following closely the direction of foliation of the enclosing rocks. Away from the main quartz body abundant stringers occur in the schist.

In the first cut above the tunnel, about 160 feet from it, the shear zone is about 9 feet wide. The foot-wall part of it consists of 3 feet of schist carrying numerous quartz stringers. This is followed by a horse of schist 2½ feet wide, above which, to the hanging-wall, is 3½ feet of blue quartz. The hanging-wall strikes north 35 degrees west and dips 60 degrees southwest.

In the next cut, some 78 feet distant, about 2 feet of quartz is exposed. The succeeding two trenches did not reach bedrock, but quartz is showing in three other trenches, the farthest about 750 feet from the portal of the adit. Beyond this the trenches show only stringers of quartz which cannot be related with certainty to the shear zone exposed in the lower trenches and adit. The values obtained from this shear are low. It is reported that the best values obtained ran about \$4.50 a ton in gold and that in some of the cuts values of \$1.20 and \$2.40 were obtained.

¹ LeRoy, O. E.: Geol. Surv., Canada, Sum. Rept. 1911; Nelson Map-area—Map.

(28) Perrier Mine

References: Ann. Repts., Minister of Mines, B.C.: 1920, pp. 132-133; 1933, pp. 220-221. LeRoy, O. E.: Geol. Surv., Canada, Sum. Rept. 1911, p. 151; Nelson Map-area.

The Perrier group of six claims is on the Great Northern railway, $3\frac{1}{2}$ miles south of Nelson, and is owned by the Perrier Gold Mines, Limited, of Nelson. The Nelson-Spokane highway passes within a few hundred yards of the mine workings, and the main, incline shaft, on the Fairview claim, is under the railway tracks.

The property was staked in 1910 and explored by the owners until 1917 when it was closed until a company could be formed and capital secured for further work. Total production, according to government reports¹, has amounted to 1,502 tons carrying, altogether, 944 ounces of gold and 2,390 ounces of silver. This represents an average of 0.628 ounce of gold and 1.58 ounces of silver a ton. Earlier shipments gave higher values than ore recently mined; since 1931, 1,302 tons have been produced with a total content of 606 ounces of gold (0.465 ounce a ton) and 1,324 ounces of silver (or 1.01 ounces a ton). Some of the ore mined recently has been concentrated at a small mill on the property and hence might be expected to run lower than ore previously mined, which was, largely, shipping ore.

The country rock consists of schists of the Rossland Volcanic group. Intrusions of granitic rocks of the Nelson batholith are shown on LeRoy's map of Nelson area² as occurring about half a mile from the property. The general strike of the foliation of the schists is north 15 to 25 degrees west and the dip from 65 degrees to the northeast to nearly vertical. The Perrier deposit is a quartz vein striking about north to north 10 degrees east and dipping 20 to 40 degrees southeast. From the incline shaft on the Fairview claim the vein has been picked up at intervals through the Perrier and into the Golden Horseshoe by means of a shaft and open-cuts. Not all of these workings were seen by the writer. The lower slopes of the hill are quite heavily drift covered and outcrops are scarce.

At the first open-cut north of the main shaft the vein strikes north 5 degrees east and dips 40 degrees to the east; it is about 18 inches wide and is well mineralized with pyrite and galena. The next point where the vein is visible is at a shaft about 600 feet northerly from the cut. This shaft is full of water, but is reported to be 30 feet deep. The dip of the vein is here 27 degrees and the width 21 inches. Seventeen tons are reported to have been shipped to Northport from this working and to have yielded \$21 a ton in gold. The other workings along the extension of the vein were not seen by the writer, but the vein is reported to have been picked up by ground-sluicing some 1,500 feet to the northeast.

¹ Ann. Rept., Minister of Mines, B.C.

² LeRoy, O. E.: Geol. Surv., Canada, Sum. Rept. 1911; Nelson Map-area.

The main workings consist of an inclined shaft following the dip of the vein, with three levels driven from it. The shaft is about 215 feet long and reaches a vertical depth of 88 feet. No. 1 level north is 21 feet vertically below the collar; No. 1 level south, 31 feet; No. 2 level, 49 feet; and No. 3 level, 75 feet below the collar. No. 1 level north is driven 260 feet from the shaft and follows the vein for this distance. The vein varies from 12 inches to 40 inches wide along the level, but the latter extreme is, apparently, caused by a roll in the vein and the normal width at this point is 14 inches. About 75 feet from the face the vein is cut by a fault striking north 5 degrees west and dipping nearly vertically. The vein west of the fault has been displaced 4 feet downward. No. 1 level south has been driven 40 feet from the shaft. At the face the vein is 30 inches wide, but includes a horse of rock which would make up half of that width. A fault striking north 25 degrees west and dipping 85 degrees northeast appears on the hanging-wall side of the drift close to the shaft. Its effect on the vein could not be seen.

No. 2 level north is about 80 feet long and the vein has been stoped above it. Near the face is a fault striking north 35 degrees west and dipping 80 degrees to the southwest. A short raise put up in the back of the drift shows vein material about 10 feet above the floor. It is probable that the western side of this fault is the downthrow side, as was the case with the fault noted on No. 1 level north. The vein in this working varies from 15 inches to 44 inches wide. The wide part consists of 2 feet of quartz on the hanging-wall and 2 inches of quartz on the foot-wall separated by 18 inches of country rock.

No. 2 level south is 80 feet long and is mostly off the vein. The latter shows up in the face, but about 10 feet back is displaced by a fault striking north 30 degrees west and dipping 80 degrees northeast. A quartz vein, 4 inches wide, appears on the foot-wall side of the level for a short distance beyond the fault, but this is dipping east at 50 to 80 degrees.

No. 3 level, north of the shaft, is 45 feet long. Thirty feet from the shaft a fault, striking north 40 degrees west and dipping vertically, has displaced the vein and the latter is not found in the remainder of the working. The fault is believed to be the same as the one in No. 2 level north. The vein at the fault dips 27 degrees and is 18 inches wide.

No. 3 level south is about 60 feet long. At the face a number of flat-lying stringers of quartz appear, with steeply dipping stringers intersecting them. For 50 feet from the face the vein is about 5 inches wide and then widens to a foot in the direction of the shaft.

A small vein, correlated with the Lucky Boy vein, cuts across the Perrier vein on the south side of the shaft just below No. 2 level south. At the intersection of the two veins is a noticeable widening of the quartz in the small vein, but neither vein appears to displace the other. Bands of mineral in the Perrier vein appear to cut across the small vein without displacement.

The Lucky Boy vein is disclosed at the surface in a small, inclined shaft about 200 feet southeast from the main shaft. At this point the deposit is a composite vein composed of stringers of quartz interbanded with schist and has a total thickness of 8 to 15 inches. It strikes north

30 degrees west and dips vertically. It is mineralized by pyrite, galena, and zinc blende, with some carbonates. Native silver, ruby silver, and free gold have been reported from this deposit, but were not seen by the writer. A gently inclined shaft, driven along the vein for 60 feet, is the only working.

(29) Venus and Juno

References: Ann. Repts., Minister of Mines, B.C.: 1930, p. 207; 1933, p. 218.

The Venus and Juno are principal claims in a group of seven owned by R. Heddle and associates of Nelson. The claims lie between elevations of 4,300 and 6,000 feet on the northern slope of Morning mountain about $2\frac{1}{2}$ miles southwest of Nelson. They may be reached by about 7 miles of steep road leading from Nelson.

The property is close to the contact of a body of the Nelson granodiorite with rocks of the Rossland Volcanic group. Near the vein this contact appears below the portal of No. 3 adit of the Venus. As no plan of the workings was available nor, for part of the examination, a guide familiar with the workings, a complete examination of the property was not attempted and only the essential facts will be presented. Some of the levels are caved at their portals; it is now understood that these are accessible by means of raises from other levels that are open.

Five main levels have been driven from the surface on the Venus vein and two on the Juno vein. In addition there are several intermediate levels. The upper three levels on the Venus claim are reported to extend to the boundary of that claim and slightly beyond into the Juno claim; the lower two levels are reported to be, roughly, 500 feet short of reaching this claim boundary. On the Venus claim there is said to be an intermediate level between the 5th and 4th adits and two intermediate levels between the 4th and 3rd adits. Below the lowest level on the Venus vein is an adit giving an additional depth of 300 feet measured on the dip of the vein. It was driven about 500 feet by the Noble Five Mining Company, Limited, but had not encountered the vein. Considerable blocks of ore have been removed by stoping above the various levels on the Venus vein.

The lowest level on the Venus vein (No. 5) is about 920 feet long and drifts along the vein for the greater part of that distance. In this level the vein varies considerably in strike, but is generally from north 25 to 40 degrees west. It dips northeast at angles ranging from 20 to 45 degrees. Along this adit the vein is from 6 inches to 2 feet wide and is composed, mainly, of quartz carrying pyrite, some galena, and very little zinc blende. Long stretches of the vein, undoubtedly the widest and best mineralized parts, have been stoped above the level. In this working the vein is in the Nelson granodiorite and, near the face, is cut off by a fault striking north 40 degrees east and dipping 60 degrees to the northwest.

The caved portals of two adits occur at distances of 200 and 400 feet, respectively, farther southeast up the slope of the hill and along the course of the vein. One of these is, possibly, an intermediate level. Farther on, the next level (No. 3?), about 500 or 600 feet from No. 5, has been driven about 845 feet southeast along the vein which strikes, in general, north

45 to 50 degrees west and dips from 20 to 45 degrees. The vein varies from about 6 inches to 18 inches wide, but in some places consists of a number of parallel stringers of quartz spread over a total width of 5 feet. The country rock consists of Rossland volcanics. A considerable part of the vein has been stoped out above and below this level; the mineralization is similar to that in No. 5 level.

Higher up the hill two adits, on the Venus vein, are caved at their portals and were not examined.

The lower Juno adit is several hundred feet higher up the hill and drifts along a vein correlated with the Venus vein. This working is also in Rossland volcanics. At 85 feet from the portal a raise comes up from the Venus workings and it is reported that the Venus ore-body passes upward into the hanging-wall of the vein in the Juno drift. For this reason there is some doubt as to whether the latter drift is actually on the Venus vein or on a vein parallel with it. The vein followed by the drift strikes north 40 degrees west and dips at 25 to 40 degrees to the northeast. It consists of stringers and bunches of quartz from 6 inches to 3 feet wide in a shear zone. This zone seems to die out at 385 feet from the portal, but the level is continued in the same direction for 300 feet more to the Juno vein which, on this level, is a mere stringer. This was raised on to the surface and an intermediate level run about 75 feet above the main level. This is a drift for 465 feet, about equal distances on either side of the raise. The Juno vein strikes about north 60 degrees east and dips 50 to 60 degrees northwest and is very nearly at right angles to the Venus vein. It consists of pyrite, with some galena, and a little zinc blende in quartz. In the face of the southwest drift the vein consists of stringers of quartz, but farther north along the drift it widens abruptly to a foot. At 115 feet from the face is the beginning of a stope, about 75 feet long, extending above the level. From it about 60 tons of ore was removed. Beyond the stope the vein continues to the northeast face and averages about 10 inches to a foot wide.

It is about 106 feet, measured along the raise, from the lower Juno adit level to the surface. Another, short, intermediate level has been run about 50 feet up the raise. This is partly caved. On the surface the Juno vein is reported to have been traced for 400 to 500 feet by means of open-cuts. The vein is said to be a foot wide and to show good values over this distance.

The property is leased by Mr. George Gormley and small shipments of sorted ore have been made by him.

The gold and silver values were as follows:

| Quantity, tons | Au, ozs. a ton | Ag, ozs. a ton |
|----------------|----------------|----------------|
| 18 | 1.165 | 1.2 |
| 17 | 2.051 | 3.2 |
| 21 | 0.683 | 1.3 |
| 15 | 1.65 | 3.7 |
| 15 | 2.859 | 3.8 |
| 29 | 2.101 | 3.5 |
| .. | 1.691 | 2.9 |

The combined production of this property and the Athabasca between 1899 and 1917 is listed in the reports of the Minister of Mines for British Columbia at 28,296 tons containing 17,915 ounces of gold and 427 ounces of silver. The Juno is credited in 1905 with a production of 1,925 tons containing 911 ounces of gold. Lessees shipped 152 tons from the property in 1932 and 1933.

(30) Athabasca

References: Leroy, O. E.: Geol. Surv., Canada, Sum. Rept. 1911, pp. 148-150, Nelson Map-area. Ann. Repts., Minister of Mines, B.C.: 1900; 1933.

The Athabasca lies at an elevation of 5,000 feet on the eastern slope of Morning mountain about 3 miles southwest of Nelson. It is reached by a branch road from the road leading to the Venus and Juno properties.

The property was idle when visited and but little time was spent on it. The writer had no plan of the workings which are partly inaccessible and which owing to the character of the deposit are difficult to describe. No guide familiar with the workings was available. Only a brief description of the property will, consequently, be attempted.

The vein is near the contact of the Nelson granodiorite with Rossland volcanic schists and passes from one formation to the other. It is a quartz vein striking about north 40 degrees east and dipping 30 to 50 degrees northwest. The vein varies in width from a couple of inches to 4 or 5 feet but is generally about a foot wide. It is mineralized with pyrite, some galena, and zinc blende. LeRoy mentions the occurrence of free gold and states that the values found are less regular in the granodiorite than in the schist belt. The ore mined was apparently high grade; the recovered values, in 1900, are stated to have averaged \$33.66 a ton in gold.

The property was recently operated by the Noble Five Mines, Limited, and in 1933 an adit was started about 600 feet northeast of the old workings and was planned to give an additional depth of 200 feet or about 300 feet on the dip of the vein. This level with two crosscuts from it and one raise is driven southwesterly for about 650 feet. These workings are in granodiorite, but so far as could be ascertained do not encounter the vein. Several fault zones striking parallel with the vein and dipping in the same direction were encountered, but showed no vein quartz.

The next level seen is some 200 feet above, and about 600 feet southwesterly from, this adit. It is about 950 feet long and, towards the face where the vein was apparently lost by faulting, a considerable amount of crosscutting has been done. This adit meets the vein at 235 feet and about 500 feet farther the vein is offset a few feet into the hanging-wall by a fault striking north 10 degrees west and dipping 78 degrees east. The drift then follows a stringer, or parallel vein, which leads back to the main vein at about 835 feet from the portal. From this point the main vein is followed northeast back to the fault by a drift that parallels the main adit for approximately 100 feet. About 700 feet from the portal inclined raises lead upwards to the upper workings. At 870 feet from the portal the main vein is, apparently, lost and a lot of crosscutting

has been done to find it and the crosscuts follow bunches and stringers of quartz close to the contact between the granodiorite and the schist. The main drift was then continued and one short segment of vein, lying between two faults, encountered. A raise has been driven on this. Those parts of the vein seen in the main drift vary from a few inches to 4 or 5 feet wide and probably average a foot. The wider sections have been stoped above the level and apparently stoped also in some sections below the level and the stopes filled. No workings connecting this with lower levels were found. It is possible that some underhand stoping was done. Numerous small faults offset the vein from a few inches to a few feet.

About 300 feet southwest from this adit, and possibly 100 to 125 feet higher, is a shaft in which the vein appears in one corner. The timbering at the collar has given away and the shaft is inaccessible. At nearly the same elevation as the shaft and several hundred feet southeasterly from it is an adit, partly caved at the portal. Owing to the weakened condition of the timbering and the back this adit was examined for only 600 feet, but is apparently much longer. Near the end of the part examined the vein passes from the granodiorite to the volcanics and, in so doing, rolls and flattens. The vein has been largely stoped above and below the part of this level examined. As on the level below, part of the adit has been driven off the vein in the foot-wall rocks and in these workings the stopes parallel the adit but are a few feet from it. LeRoy states that in the schists the vein is much more disturbed by faults than in the granodiorite and that offsets range from a few inches to over 100 feet. Lamprophyre dykes cutting the vein are commonly found along these faults.

(31) Granite-Poorman Mine

References: LeRoy, O.E.: Geol. Surv., Canada, Sum. Rept. 1911, pp. 146-148, Nelson Map-area. Ann. Repts., Minister of Mines, B.C.: 1916, pp. 144-146; 1928, pp. 320-321.

This property lies about 5 miles west of Nelson, a short distance south of the main highway between Nelson and Trail. It is being developed by the Livingstone Mining Company of Seattle, Washington. The property is one of the old mines of the district; has passed through many hands; and has been repeatedly worked by lessees. Past production is estimated at over \$1,000,000 and was made chiefly during the period 1899 to 1912.

The workings occur in granodiorite of the Nelson batholith and expose fissure veins striking slightly west of north and dipping easterly at about 45 degrees. The gangue is quartz and the chief metallic mineral is pyrite. The latter is associated with galena and chalcopyrite. Free gold and scheelite have been reported from the Poorman workings. The veins are fairly narrow, but so far as traced by the workings are remarkably persistent in strike. Five main veins have been developed, namely, from west to east, the Hardscrabble, Poorman, Greenhorn, Granite or White, and Beelzebub. In addition there is the Hardup vein, lying between the Hardscrabble and the Poorman; another unnamed vein between the Poorman and the Greenhorn; and several others to the east and west of the workings.

A long, low-level drift, not shown on the accompanying plan of the workings, was formerly driven from the old mill site near Kootenay river at Taghum, but was not driven far enough to reach known sections of the veins. A new crosscut adit has been started at the level of the new mill and is aimed to strike the Hardscrabble vein some 300 feet north of its most northerly exposure underground.

The No. 4 Poorman adit, at elevation 2,800 feet, is the main level in workings on both the Poorman and Hardscrabble veins. The latter is encountered just inside the portal and is drifted on southerly for 850 feet on this level. About 200 feet from the southerly end of this drift a winze has been sunk to lower levels on this vein. An intermediate level has been driven 250 feet north and 200 feet south of the winze at about 100 feet below the main level. A lower level, at approximately the same elevation as the No. 6 of the Poorman workings, has been driven very nearly the same distances north and south of the winze. It is connected with the lower Poorman level by a crosscut. The latter is not shown on the plan as it lies under one of the raises in the Poorman mine.

The main, Hardscrabble drift encounters an ore shoot that persists almost to the south end of the level or for about 600 feet. In this distance the vein varies from 8 to 16 inches wide and dips easterly at 45 to 50 degrees. At the south end the vein is a stringer, but widens in the stope above. On the intermediate level below the vein maintains a width of 2 to 2½ feet and has been partly stoped out, leaving, it is stated, an ore-body 100 feet long. In the south drift there is stated to be 225 feet of unstoped ore. The ore between the lower and intermediate level is largely unstoped. Above the main level the ore has been very largely stoped to the surface. On the lowest level the vein appears to flatten considerably in those parts that could be examined. Work of cleaning up on this lower level was in progress at the time of the writer's visit.

The Hardup vein appears as a stringer, 2 to 3 inches wide, 300 feet east of the Hardscrabble vein in the crosscut adit to the Poorman vein, and also appears in this position in the crosscut between No. 6 level of the Poorman mine and the lowest level of the Hardscrabble mine. It strikes north 10 to 15 degrees west and dips 40 degrees to the northeast, and is heavily impregnated with pyrite. It has not been driven on.

The Poorman vein lies about 400 feet east of the Hardscrabble vein. No. 4 level drifts southerly on the vein and several levels lying between this and the surface have been driven and connected by raises. The upper levels were not examined. About 75 feet south from the intersection of the vein and the crosscut on No. 4 level an inclined winze has been sunk to a depth of 220 feet and two levels, Nos. 5 and 6, have been driven southerly from it. One raise connects No. 6 and No. 5 and three raises connect No. 5 with No. 4. An ore shoot, approximately 1,100 feet long on No. 4 level, has been stoped from No. 4 to the surface. This shoot varied from a few inches to nearly 8 feet thick and averaged about 2 feet. The same shoot is stoped for 450 feet on No. 5 level. Good ore is stated to remain in the floor of No. 5 and also in the southern faces of the stopes above that and No. 4 levels. On the latter the vein narrows to 8 inches at the face. This ore shoot, like others on the property, rakes south at a low angle. In the short drift to the north from the intersection of the crosscut adit

with the vein is a fault striking north 80 degrees east and dipping vertically. This has cut off the vein. The lowest or No. 6 level has been driven entirely off the vein. The vein is lost in the winze immediately below No. 5 level and from this point down the winze follows a stringer which disappears as the lowest level is reached. Some crosscutting has been done to locate the vein at this level but without success. As the rake of the ore would carry the shoot to the south of the present workings, work should be done farther south on this level. It is obvious that as the crosscut to the Hardscrabble vein on No. 6 level explores the foot-wall rocks, the Poorman vein, if it persists to this level, must be sought in the hanging-wall country and, preferably, down the rake of known ore-bodies.

No. 5 level could not be examined on account of water dammed back in it. It is possible that a split has occurred in the vein on this level and that the main vein has flattened, but no sign of a split could be seen in the winze.

The workings on the Greenhorn vein are not accessible and no work is being done on that vein. According to LeRoy¹ the vein strikes north 33 degrees west and dips northeast at 45 degrees. An ore shoot 300 feet long with an average thickness of 3 feet was mined.

The lower, or most northerly, Granite adit is approximately 230 feet above the No. 4 Poorman level. It is a crosscut for 150 feet to the Granite vein and from that point a crosscut, now caved, leads to the Greenhorn vein. The Granite vein is drifted on for 250 feet to where it is cut off by a fault striking east and dipping 45 degrees north. The fault is crossed and then drifted on east for 200 feet, the drift gradually crossing the fault plane a second time near its end. From this working a long drift was run south to a point underneath the ore shoots in the upper Granite mine and one crosscut made. None of these workings encountered the vein. A raise was then put up from this south drift for 225 feet at an average angle of 70 degrees and inclined in the same direction as the vein. This still did not encounter the vein, so an incline, sloping gradually upwards and towards the east, was driven from the top of the raise. This broke into the old stopes above the upper Granite level and showed that the lower workings lay in the foot-wall of the Granite vein. From about half-way up in the raise a second raise, inclined steeply upwards towards the east, was then driven and encountered the vein. A sub-level is now being driven south to connect with the bottom of the shaft which is filled with water. At the time of the writer's visit the south face of this intermediate level showed the vein 40 inches wide. In the north drift, which has been run 70 feet from the raise, the vein averages a foot to 18 inches wide and contains a section of high-grade ore. This is very heavily pyritized and a carload is stated to have assayed \$78 a ton.² The ore obtained in driving this drift is being sent to the mill.

The upper Granite adit is about 1,000 feet long, with the shaft, mentioned above, sunk from the surface in the hanging-wall of the vein about 180 feet northerly from the southern face of the drift. At the face the vein is a stringer, but farther north widens rapidly to about a foot. The width varies a lot between the shaft and the portal. Three shoots of ore

¹ Ibid, p. 148.

² Gold at \$35 an ounce.

were encountered in this working and stoped above. The first lay immediately north of the shaft and was about 100 feet long; the second was about 70 feet north of this and was about 350 feet long; and the third again 75 feet to the north and about 130 feet long. The last is, however, believed to be on the Duncan stringer. Some 400 feet from the portal the vein branches to the hanging-wall side and one branch, referred to as the Duncan stringer, is the one followed in from the portal. It is believed that the branch to the hanging-wall side of this stringer is the main vein and that the erroneous correlation of this stringer with the Granite vein led to the misplacing of the lower workings.

The upper granite levels were driven from the shaft and are connected by raises. They were not examined, as it is believed the ore has been largely stoped out. They form the most southerly of the Granite workings shown on the accompanying map.

The Beelzebub workings were not open at the time of the writer's visit. The upper part of the stopes could be seen, but the levels were not accessible. LeRoy¹ states that the vein was opened by two levels, 175 feet apart, and that the vein varies in strike from north 30 to 40 degrees west and dips northeast at from 30 to 50 degrees. The width, as stoped, varied from 14 to 22 inches. One pocket of extremely rich oxidized ore was encountered.

Using the machinery from the old mill, a new ten-stamp mill has been erected close to the portal of the new crosscut adit. Operations began late in the summer and no statement as to results obtained is available.

(32) Star and Alma N. Claims

These claims, owned by George Matthews of Salmo, lie at an elevation of 4,800 feet on the divide between Eagle and Sandy creeks and about 5 miles southwest of Nelson. They are reached by a road that leaves the main highway for Blewitt post office. A branch of this road leads up Eagle creek and past the Granite-Poorman property to the camp which is close to the Star workings. The claims are under option to a Tacoma syndicate. The property was idle at the time of the writer's visit, a watchman being in charge.

The deposits are reported to have been discovered in 1897 by ground-sluicing. A shaft on the Star was sunk to a depth of 90 feet and some drifting done. It is reported that a small lot of ore was shipped to Trail in 1904 and that this carried 0.63 ounce in gold a ton, 2.2 ounces of silver, and 1.2 per cent copper. In 1912 a group from Spokane purchased an interest in the property and took an option on the remainder. They leased the Granite-Poorman mill and hauled ore by team to the tramway terminal. They stoped out a body of ore 70 by 14 by 18 feet in size. All the excavated material is reported to have been put through the mill and a value of \$5.40 a ton recovered. The percentage of loss is not stated. In 1932 the property was examined by R. R. Hedley to whom the writer is indebted for much information on the history and values contained. The deposit is a mineralized shear zone and does not outcrop near the work-

¹ LeRoy, O. E.: Geol. Surv., Canada, Sum. Rept. 1911, p. 148; Nelson Map area.

ings. The rocks underground are highly altered, but apparently belong to the Rossland Volcanic group. They are close to the contact of the Nelson granodiorite and several small tongues of this rock are traversed by the shear zone.

The workings on the Star consist of a vertical shaft 90 feet deep, with drifts at a depth of 60 feet, running 80 feet to the north and 60 feet to the south. The shear zone strikes north 10 degrees east and is nearly vertical. It carries throughout an irregular quartz vein which, in places, is only a stringer, but in others swells to as much as 40 inches. The vein includes a considerable amount of country rock and the whole is mineralized with pyrite, chalcopyrite, and malachite. The sulphides are not confined to the vein but are found in the sheared rock on either side. This is shown by the walls of the old stope referred to above, which has a width of 14 feet. The country rock is highly sheared and altered so that it is difficult to determine its original composition. In the drift to the south of the shaft a lamprophyre dyke, about a foot wide, cuts across the shear about half-way between the shaft and the face. From the workings it is difficult to tell the width of the zone as well-defined walls are in evidence in only a few places. It is apparent that the widths of the stopes were determined by assay values rather than by true walls. Two samples were taken by Mr. Hedley. One, near the shaft and 39 inches wide, gave 0.57 ounce in gold a ton. The other, from the south face and across, 12 inches, gave 0.76 ounce in gold a ton.

On the Alma N, about 400 yards southeasterly from the Star workings, gold values are found in quartz and silicified country rock along an irregular contact between the Nelson granodiorite and the rocks of the Rossland Volcanic group. The overburden here is 2 to 9 feet thick and although a number of cuts have been put down to bedrock some of these have sloughed in. Two shafts 250 feet apart and 30 to 40 feet deep have been sunk and a little drifting done from the bottoms.

At the northern end of the deposit exposed by the open-cuts (about 50 feet northeast of the nearest shaft) is a dark, decomposed, dioritic rock which according to reports carried a rich streak of ore. No quartz was seen and very little pyrite. At the bottom of the north shaft a crosscut, 18 feet long, is driven south 70 degrees east. Apparently this working follows a cross seam or wall in the diorite. The rock is thoroughly decomposed, but contains residual nodules of hard, fairly fresh diorite. Black manganese oxide occurs along the joint planes of the rock, and specks of pyrite occur throughout. The crosscut does not seem to show either the width or attitude of the deposit.

The south shaft is about 35 feet deep and a drift runs southerly from the bottom for about 80 feet. The rock at the face is decomposed and yellowish and contains small bunches and crystals of hornblende. Near the face is a fault striking north 75 degrees east and dipping 85 degrees southeast. Fifteen feet from the face another fault strikes south 70 degrees east and dips 75 degrees southwest. All the country rock up to this fault is slightly impregnated with pyrite. North of the fault are schists of the Rossland group impregnated with pyrite and stained with malachite. The foliation strikes about north and dips to the east at a low angle. About 55 feet from the shaft a winze was put down about 8 feet and is stated

to have been sunk at this point, because unoxidized ore was encountered. It was full of water, but some of the ore from it was stated to be on a platform at the shaft. This was examined by the writer and found to carry impregnations of pyrite, a little chalcopyrite, and some galena. Two samples, taken by Mr. Hedley, gave 0.55 and 0.90 ounce in gold to the ton. Between the winze and the shaft the drift is lagged. In part the rocks in this section consist of schists of the Rossland Volcanic group. The drift was carried 8 feet northerly from the shaft and a stope was run from here nearly to the surface. This was inaccessible, but the excavated material, amounting to about 40 tons, was cribbed up near the shaft. A grab sample of this, taken by Mr. Hedley, yielded 0.35 ounce in gold a ton.

About 40 feet south of the south shaft is a large open-cut. The outer part of this is in overburden, but the remainder exposes a yellowish gossan with small veinlets and bunches of quartz along slips striking northeast and dipping west to northwest at low angles. Pyrite has, apparently, been present in the zone, but is oxidized.

The full width of the zone cannot be seen, owing to sloughing of the cut, but is probably about 40 feet. The cuts to the south of this large open-cut are sloughed, as are also the cuts to the north of the southerly shaft. A grab sample from this open-cut by O'Grady¹ assayed 0.17 ounce gold a ton and 1.2 ounces silver. Sampling along the drift at the same time gave the following results: south side of drift, 30 feet from the shaft, width, 72 inches—gold, 0.07 ounce, silver, 0.6 ounce a ton; south side of drift 40 feet from shaft, width, 72 inches—gold, 0.50 ounce a ton, silver 1.8 ounces a ton; at the same place but across 48 inches—gold, 0.39 ounce a ton, silver, 1.7 ounces a ton; north side of drift, 35 feet from shaft—gold, 0.09 ounce a ton, silver, 1.1 ounces a ton, copper, 0.34 per cent.

It is reported that a small shipment of ore from this property carried 3.7 ounces of gold a ton and 7 ounces of silver. This is undoubtedly from sorted ore.

Some 400 feet to the east and, possibly, 100 feet below the Alma N showing, an adit has been driven about 370 feet with a crosscut, 85 feet long, near the face. This adit curves to the south and does not get under the workings higher up the hill. In the crosscut is a zone, about 20 feet from the main adit, heavily impregnated with pyrite, but showing no walls. A similar occurrence is found in the main adit about 70 feet nearer the portal than the crosscut. No data as to the values obtained in this work could be secured. A point underneath the upper workings could be reached by a relatively short crosscut from this adit.

The work done to date does not throw a great deal of light on the character or trend of the deposit which is probably a shear zone, following the granodiorite contact and striking northeast. The values obtained in places and the width of the zone suggest that the deposit is worth further exploration. It is probable that average values, over the widths indicated, are low and may, possibly, be below commercial grade.

¹Ann. Rept., Minister of Mines, B.C., 1930.

(33) Royal Canadian and Nevada

References: LeRoy, O. E.: Geol. Surv., Canada, Sum. Rept. 1911, p. 151, Nelson Map-area. Ann. Repts., Minister of Mines, B.C.: 1928, pp. 321-322; 1933.

This property is reported to be partly owned by, and partly under option to, the Kootenay Nevada Mines, Limited. It consists of eleven claims and fractions and lies south of the Nelson-Bonnington road and about 7 miles west of Nelson. The property was idle at the time of the writer's visit.

The country rock consists of granodiorite of the Nelson batholith containing a small inclusion of the Rossland volcanics. The surface is heavily drift-covered and rock outcrops are very scarce.

The Royal Canadian vein is a quartz vein striking north 15 degrees west and dipping northeast at 60 to 70 degrees. It is mineralized, chiefly, with pyrite and a little chalcopyrite. Values are mainly in gold. Four adits have been driven south into the hillside on the direction of the vein strike and at elevations of 3,466 feet, 3,345 feet, 3,287 feet, and 3,200 feet, respectively. Of these the uppermost or No. 1 adit is 210 feet long and is entirely off the vein. This adit was, undoubtedly, driven as a crosscut toward the Nevada vein above, but failed to reach its objective. In a short drift easterly a small slip in the granite is followed. The rock is there impregnated with pyrite. Also, about 95 feet from the portal, considerable pyrite appears in the granite. A small quartz stringer 75 feet from the portal strikes about east and dips 60 degrees north. It has a maximum width of 4 inches and is heavily impregnated with pyrite. Irregular bunches of quartz, mineralized with pyrite, appear in the rock 35 feet from the portal.

No. 2 adit is about 315 feet long with a short crosscut driven 15 feet to the northeast. About 45 feet from its face the adit follows the Royal Canadian vein for 165 feet to where it is cut by a fault striking northeast and dipping northwest. The southern segment of the vein is offset a few feet to the west with respect to the northern segment. Beyond the fault the adit was not examined, as a cave in the roof had backed water up in the tunnel. However, according to information received, the vein is much weaker and the values poorer beyond the fault. The vein is stoped above the level for 90 feet and a raise is driven through to the surface. About 35 feet from the portal is the top of a raise from No. 3 adit. The width of the vein where it can be seen varies from about 12 to 15 inches; parts of the back of the tunnel are tightly timbered so that the vein cannot be seen.

No. 3 adit is about 450 feet long and includes one short crosscut, driven southeasterly. The fault referred to above is encountered at 235 feet from the portal and offsets the southern part of the vein about 27 feet to the southwest. The faulted part of the vein is picked up by a crosscut along the fault plane and is then followed for 187 feet to the face of the adit. A stope about 70 feet long, with a raise to the level above and a short intermediate level from the raise, have been run from this level a short distance north of the fault. North of the fault the vein varies from 6 inches to 2 feet wide. The short, southeasterly crosscut, just south of the fault, follows irregular bunches of quartz in the granite.

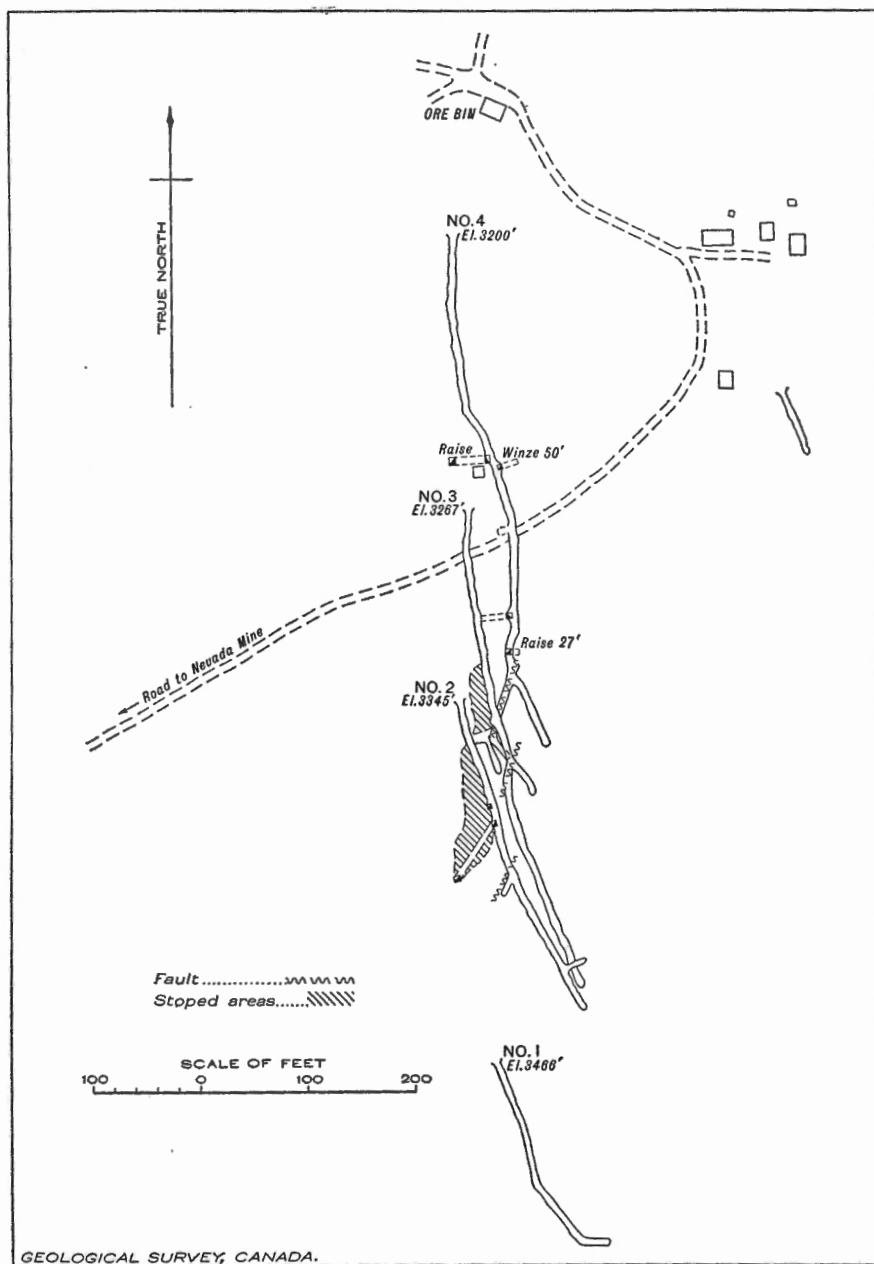


Figure 8. Royal Canadian mine, Ymir-Nelson area, Kootenay district, British Columbia; plan showing workings.

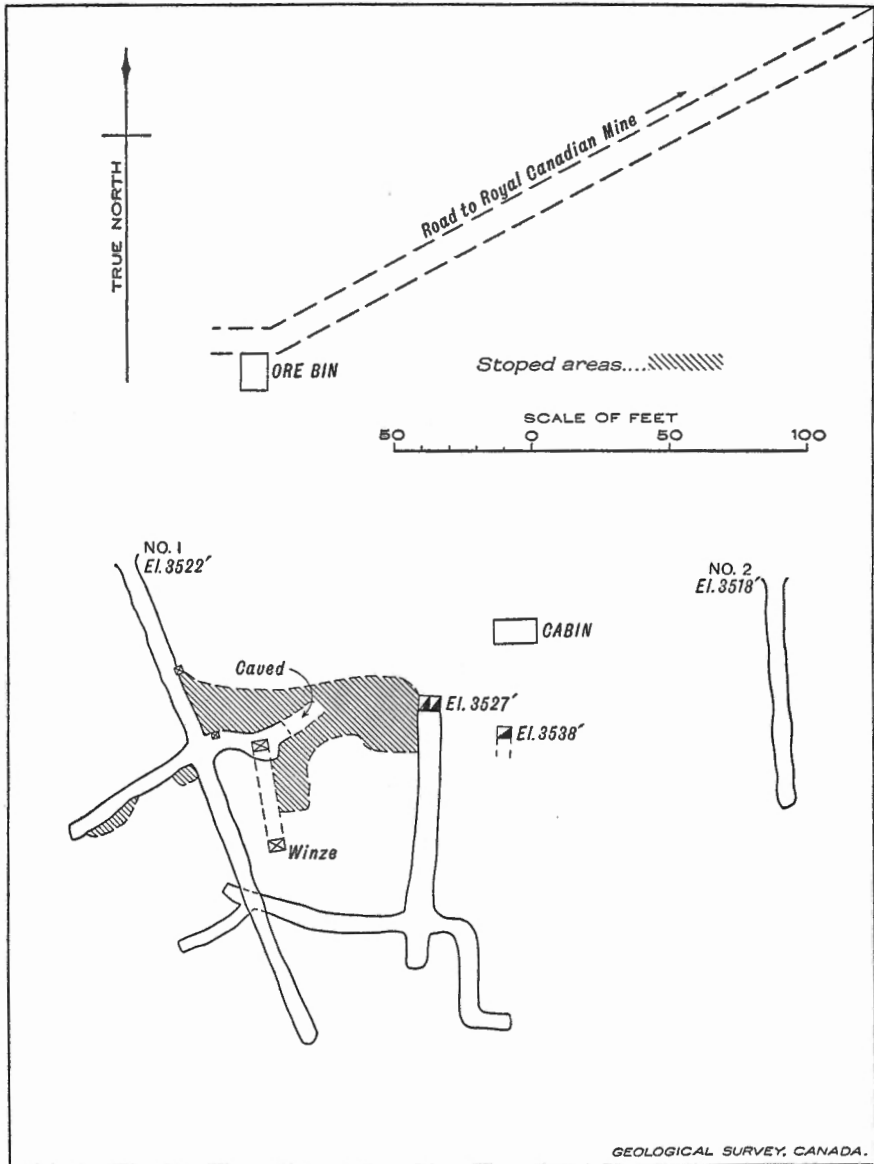


Figure 9. Nevada mine, Ymir-Nelson area, Kootenay district, British Columbia; plan showing workings.

The strike of the main fault is there north 40 degrees east and the dip varies from 40 to 60 degrees northwest. South of the fault the vein varies from a mere seam to 14 inches wide. It is well-marked throughout, but values are probably low.

No. 4 level is 420 feet long to the point where the main fault is encountered. The fault plane has been drifted on southwest for 75 feet and at the end of the drift is a 25-foot crosscut run southeasterly through the fault plane. This does not pick up the vein. However, a section of the vein is found and followed in a drift starting just beyond the intersection of the adit and the fault plane. The discovery of the vein beyond the fault so nearly in line with the main drift on this level is due to the fact that the main drift has been largely driven off the vein. In the section of the drift beyond the fault, about 75 feet long, the vein varies from 4 to 6 inches wide and carries considerable pyrite. It is reported that values encountered in the drift north of the fault were poor, but that they were encouraging south of the fault. This is the reverse of the conditions found on the upper levels. At 210 feet from the portal is a raise to the surface and, a short distance farther, a winze 50 feet deep. At 360 feet there is a raise to the level above and, near the fault, a 27-foot raise driven toward the hanging-wall. Along a considerable part of this level the vein is displaced by a flat-lying, lamprophyre dyke. Short stretches of the vein appear in the tunnel floor or back and the vein has been developed above and below the level by the raises and winze mentioned. One section of the vein, about 60 feet long, appears at 90 feet from the portal and another section, 90 feet long, is south of the winze. In several places the vein narrows to a stringer, goes off into the wall of the adit, and its place is taken by another vein of quartz arranged *en échelon* with the last. In these places there is no apparent faulting.

The Royal Canadian workings are said to have produced about \$36,000 worth of ore.

The Nevada workings lie 1,500 feet southwest of, and 325 feet above, the lowest or No. 4 adit on the Royal Canadian vein. They comprise two adits and a shaft. All are at almost the same elevation.

The shaft is an incline sunk 100 feet on the vein, with two drifts from it, one easterly and the other westerly. The shaft was full of water when visited early in September.

The No. 1 Nevada adit 130 feet northwest of the shaft is a cross-cut driven southeasterly about 150 feet. It encounters the vein at 75 feet and continues past it. From the point of intersection a drift has been run southwesterly along the vein for 55 feet and another for 30 feet northeasterly. Near the face of the latter is a winze sunk 60 feet on the vein. The vein strikes north 80 degrees east, nearly at right angles to the Royal Canadian vein, and dips 50 degrees to the southeast. It follows the contact of granodiorite with the inclusion of the Rossland volcanics mentioned above and, for part of this distance, is precisely at the contact between these two rocks. The vein varies from about 8 inches to 4½ feet wide and carries stringers and bunches of quartz well mineralized with pyrite. The easterly drift connects with a stoped-out area above and

below the level of the drift. In the western drift there is a short underhand stope from which 3 tons of high-grade ore was taken.

The Nevada No. 2 adit lies about 135 feet east of the shaft and is 80 feet long. It does not encounter the vein.

It is stated that 100 tons extracted from the stope on the east drift of the Nevada vein were milled at the Granite-Poorman mill and yielded between \$35 and \$40 a ton.

INDEX

| | PAGE | | PAGE |
|---|-------------|---|--------------|
| Acknowledgments. | 1 | Gold Cup Mining Co., Ltd. | 44 |
| Alma N. cl. | 69-71 | Gold Cup No. 3 cl. | 44 |
| Anderson, O. | 13 | Golden Age property. | 58, 59 |
| Apex gp. | 59-60 | Golden Age Mining Co., Ltd. | 58 |
| Arlington Mining Co. | 7 | Gold Fern Mines, Ltd. | 48 |
| Athabasca cl. | 65, 66 | Gold King gp. | 53-55 |
| Barnhardt, G. H. | 46 | Gold Queen cl. | 17-19 |
| Baw, S. | 32 | Goodenough m. | 3, 32, 34-37 |
| Beaver Mountain-Rossland group. . | 2 | Gormley, George. | 64 |
| Beelzebub vein. <i>See</i> Granite Poor- | | Granite porphyry. | 3 |
| man m. | | Granite or White vein. <i>See</i> Granite- | |
| Benwell, George, jun. | 59 | Poorman m. | |
| Bi-Metallic gp. | 32 | Granite-Poorman m. | 66-69 |
| Blackcock gp. | 39-42 | Granodiorite. | 2, 6 |
| Black Diamond cl. | 26 | Grassroot vein. <i>See</i> Fern m. | |
| Black Diamond vein. <i>See</i> Two | | Greenhorn vein. <i>See</i> Granite- | |
| Star gp. | | Poorman m. | |
| Boese, Delyle. | 1 | Grobe, D. E. | 13 |
| Bremner, J. | 32 | Hardscrabble vein. <i>See</i> Granite- | |
| Campbell, A. J. | 38 | Poorman m. | |
| Canadian Girl cl. | 26 | Hardup vein. <i>See</i> Granite-Poorman | |
| Canadian Pacific Exploration Co. . | 46 | m. | |
| Carthage gp. | 37, 38 | Hauketahl, E. P. | 16 |
| Centre Star m. | 3, 5, 20-24 | Heddle, R. | 63 |
| Champagne cl. | 16 | History of area. | 1 |
| Coats, J. F. | 59 | Hobson Silver-Lead Co., Ltd. | 27 |
| Crown-granted Jubilee cl. | 17 | Hunter, W. Roy. | 38 |
| Cullinane, J. A. | 42 | Hydroelectric development in area. . | 1 |
| Cullinane, J. J. | 42 | Ida D. cl. | 10 |
| Curtis, Smith | 46 | Ida D. vein. <i>See</i> Second Relief m. . | |
| Curwin, S., properties owned by. . | 17, 19, 32 | Imperial cl. | 13-16 |
| Dewey cl. | 17-19 | Juno cl. <i>See</i> Venus and Juno | |
| Dundee m. | 3, 25, 26 | Jubilee cl. | 17-19 |
| Dundee Mining Co., Ltd. | 25 | Jurassic rocks | 3 |
| Enterprise Consolidated Mining Co., | | Klondyke No. 1 fraction cl. | 26 |
| Ltd. | 34 | Kootenay Nevada Mines, Ltd. | 72 |
| Euphrates gp. | 55-58 | Lakes, Arthur | 1, 14 |
| Euphrates Mining Co., Ltd. | 55 | Lakes, Harold | 1, 14 |
| Evening Star cl. | 31 | Lakeview cl. | 26 |
| Fern m. | 48-52 | Lakeview vein. <i>See</i> Yankee Girl m. . | |
| Fern Gold Mining and Milling Co. . | 48 | Livingstone Mining Co. of Seattle, | |
| Fisher, J. E. | 53 | Wash. | 66 |
| Fissure veins, mineralization of. . | 3, 6 | Location and extent of area. | 1 |
| Franklin cl. | 16 | Log Cabin vein. <i>See</i> Euphrates gp. . | |
| Galena. | 3, 6 | Lucky Boy vein. <i>See</i> Perrier m. | |
| Geology, economic. | 3-76 | McCallum, H. L. | 1 |
| General. | 2, 3 | McIsaac, C. | 32 |
| Georgia cl. | 13 | McMillan, A. | 39 |
| Gille, J. M. | 25 | Matthews, George | 69 |
| Gold. | 3-7 | Mining Corporation of Canada. | 27 |
| <i>See also</i> Individual properties | | Minto vein. <i>See</i> Euphrates gp. | |
| Gold Cup m. | 6, 44-46 | Moline, Frank | 42 |
| | | Molybdenite. | 6, 9 |

| | PAGE | | PAGE |
|--|-----------|---|----------------------|
| Morning Star cl..... | 31 | Sphalerite..... | 3, 6 |
| Myrtle gp..... | 19 | Spotted Horse cl..... | 47, 48 |
| Nelson batholith..... | 2 | Spur vein. <i>See</i> Yankee Girl m. | |
| Nevada cl. (Porcupine ck.)..... | 13-16 | Star cl..... | 69-71 |
| Nevada m..... | 72, 74-76 | Sunrise cl..... | 16 |
| Nickel Plate vein. <i>See</i> Euphrates gp. | | Tamarac King Solomon gp..... | 43, 44 |
| Noble Five Mines, Ltd..... | 63, 65 | Tertiary rocks..... | 3 |
| Norcross, D. H..... | 42 | Terzian, E..... | 58 |
| Ogenski, Frank..... | 59 | Terzian, S..... | 58 |
| Ogenski, Joe..... | 59 | Texas Yankee Girl, Ltd..... | 27 |
| Ogenski, John..... | 59 | Three Friends gp..... | 52, 53 |
| Ohio No. 1 cl..... | 44 | Toad mt..... | 1 |
| Oldman vein. <i>See</i> Fern m. | | Transportation facilities..... | 1 |
| Pend d'Oreille group..... | 2, 3, 34 | Triassic rocks..... | 2 |
| Perrier m..... | 61-63 | Trites Gold Mining Co., Ltd..... | 31 |
| Perrier Gold Mines, Ltd..... | 61 | Two Star gp..... | 31 |
| Petersen, Nels..... | 16 | Tyne cl..... | 17-19 |
| Petersen, W..... | 16 | Veins, types and mineralization.... | 3, 5, 6 |
| Poorman vein. <i>See</i> Granite-Poorman m. | | Venus and Juno cl..... | 63-65 |
| Porcupine gp..... | 16, 17 | Volcanic rocks. <i>See</i> Rossland Volcanic gp. | |
| Porcupine Goldfields Development and Finance Corp., Ltd..... | 27, 34 | Wesko Exploration and Development Co., properties developed by..... | 1, 5, 14, 15, 18, 20 |
| Porto Rico m..... | 6, 46, 47 | Widdowson, E. W..... | 43 |
| Power development in area..... | 1 | Wilcox m..... | 3, 42, 43 |
| Premier Gold Mining Co., Ltd.... | 7 | Wragge, E..... | 46, 47 |
| Railways..... | 1 | Yankee Girl m..... | 3, 26-31 |
| Redman vein. <i>See</i> Centre Star m. | | Yankee Girl vein. <i>See</i> Yankee Girl m. | |
| Relief-Arlington Mines, Ltd..... | 7 | Yankee Girl Consolidated Mines, Ltd..... | 27 |
| Rio Grande cl..... | 13 | Yankee Girl Gold Mines, Ltd..... | 26 |
| Roanoake gp..... | 38 | Yankee Girl, Ltd..... | 27 |
| Rossland Volcanic gp..... | 2, 5 | Ymir m..... | 3, 32-34 |
| Royal cl..... | 25 | Yankee Girl Consolidated Mines, Ltd..... | 32 |
| Royal Canadian m..... | 72-76 | Ymir Dundee Gold Mining Co., Ltd..... | 25 |
| Sandauphin cl..... | 13 | Ymir Gold Mining Co..... | 34 |
| Second Relief m..... | 6, 7-12 | Ymir-Wilcox Development Co.... | 42 |
| Second Relief Mining Co., Ltd.... | 7 | Ymir Yankee Girl Gold Mines, Ltd. | 27 |
| Shear zones, minerals..... | 6 | Yukon fraction cl..... | 26 |
| Shiloh cl..... | 25 | | |
| Silver..... | 6 | | |
| <i>See also</i> Individual properties | | | |
| Silver King m..... | 1 | | |