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DEPARTMENT OF MINES AND RESOURCES

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GEOLOGICAL SURVEY

MEMOIR 223

Mineral Resources, Hazelton and Smithers Areas, Cassiar and Coast Districts, British Columbia

BY

E. D. Kindle

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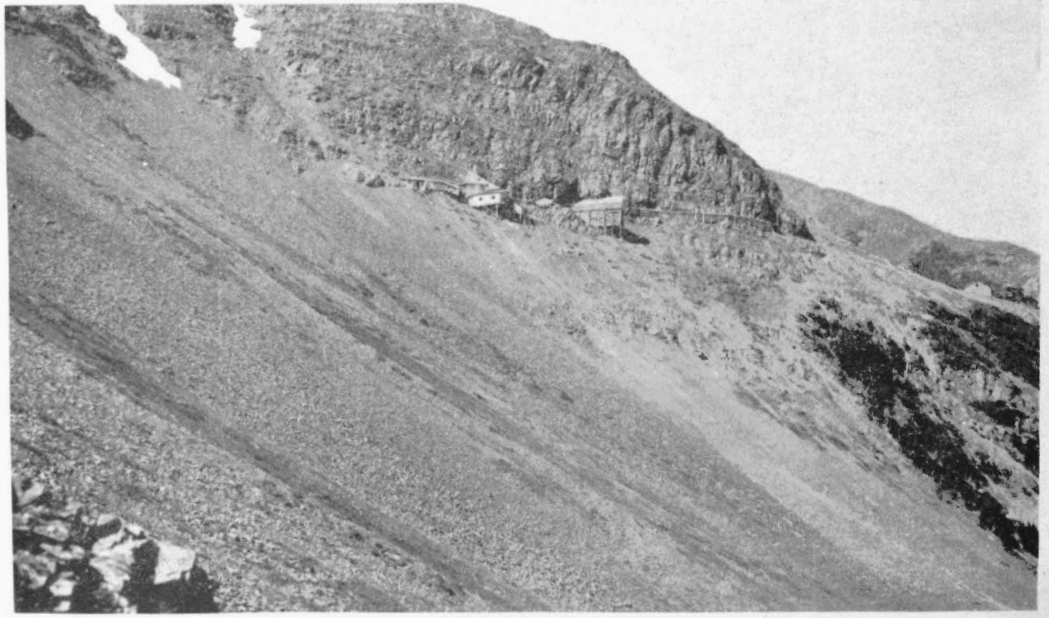

Looking west across Silver Cup Basin at Silver Cup mine.

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INTRODUCTION

GENERAL STATEMENT

This report deals with mineral deposits examined during the 1937 and 1938 field seasons in the vicinity of Hazelton and Smithers. All the known mineral properties near Hazelton and those on the north half and southwest slope of Hudson Bay Mountain at Smithers are described. Certain mineral prospects near Smithers, most of them on the southeast slope of Hudson Bay Mountain, were not examined because of lack of time and are not described here. The names of these prospects are as follows: Vancouver group, Cascade group, Yukon group, Jessie group, Heather group, Empire group, Dorothy group, Lonesome Star group, Snowshoe group, Zobnic group, Zeolotic group, Pine Ridge group, Smithers group, Canadian Citizen group, Neepawa group, Trixie group, and Patriotic group. A number of mineral deposits in Driftwood Creek area, in Babine Mountains, 15 miles east of Smithers, also were not examined, and the coal and mineral occurrences in Telkwa River area, 10 miles south of Smithers, were not visited.

Hazelton, the most northerly point on the Prince Rupert line of the Canadian National Railway, is 177 miles by rail northeast of Prince Rupert. Smithers lies 38 miles southeast of Hazelton, but the distance by railway or highway is 48 miles. Smithers, with a population of about one thousand persons, is the largest town along the railway between Prince Rupert and Prince George. It is the shopping centre of a farming community, and all articles of commerce may be purchased there. Railway repair shops are located at Smithers, and a substation of the Dominion Experimental Farm was established 5 miles south of it in 1938. Hazelton, though much smaller, is also an active trading centre and much business is done. Smithers and Hazelton are served by a good road, which runs east to connect with the Caribou-Vancouver highway at Prince George. The road is being extended southwest from Hazelton to reach Terrace. Hazelton is off of the main air routes, but its small, serviceable landing field is frequently used.

The district is noted for the variety of its mineral deposits, which contain gold, silver, lead, zinc, copper, antimony, bismuth, cobalt, tungsten, molybdenum, and coal. Gold-copper ore was first discovered in 1899 on Telkwa River. In 1901 coal leases were staked there and in the vicinity of Kispiox, north of Hazelton. Silver-lead-zinc ore was discovered on Hudson Bay Mountain in 1905, and in 1908 similar ore containing antimony was found on Nine Mile Mountain at Hazelton. During the next

few years many mineral bearing veins were discovered and staked on Nine Mile and Glen Mountains northeast of Hazelton, on Rocher Déboulé Mountain south of Hazelton, and on Hudson Bay Mountain. Between 1910 and 1930 development work was carried out from time to time on seventy-five groups of claims in these areas. Small shipments of high-grade silver-lead ore were made from fifteen different properties and four producing mines were operated, namely, the Silver Cup, Silver Standard, and Rocher Déboulé mines at Hazelton, and the Duthie mine near Smithers.

Development work at the Silver Cup mine progressed from time to time from 1914 until 1928, during which period 375 tons of hand-sorted silver-lead-zinc ore were shipped. A 50-ton capacity flotation type mill was built and operated during 1929, treating 5,710 tons of ore to produce 571 tons of concentrates. Between 1913 and 1917 the Silver Standard mine shipped about 3,000 tons of selected silver-lead-zinc ore. The Silver Standard mill, of 50 tons daily capacity, treated about 9,000 tons of ore from 1919 until 1922. In 1923 the production record of this mine was given as 14,500 tons of ore mined and milled, to produce concentrates with a gross value of $500,000. The Rocher Déboulé mine was operated from 1914 until October 1918 to produce 39,833 tons of ore, containing 4,214 ounces of gold, 62,865 ounces of silver, and 5,746,306 pounds of copper, having a gross value of about $1,000,000. Underground work at the Duthie mine commenced in 1922, and during the next 5 years several shipments of hand-sorted silver-lead-zinc ore were made. In 1927 a 50-ton capacity flotation mill was completed, which was operated until suspension of mining early in 1930. This mine produced ore having a gross value of over $1,000,000.

Very little was done in the way of mining between 1930 and 1936, but during the last few years there has been a revival of interest. Commencing in 1938, Canadian Cadillac Gold Mines, Limited, have been actively developing the Silver Standard mine, and some high-grade ore was shipped early in 1939. S. F. Campbell and associates shipped a carload of silver-lead-zinc ore from Glacier Gulch in 1937, and during 1938 got out several shipments of high-grade gold ore from the Glacier Gulch Gold group.

All the mining properties described here have been examined from time to time and briefly described by the Resident Engineer of the British Columbia Department of Mines. His descriptions are in the Annual Reports of the Minister of Mines of British Columbia, references to which are listed under the title of each mining property. W. W. Leach, R. G. McConnell, and G. S. Malloch carried out the first geological work for the Geological Survey of Canada in this district between 1908 and 1912. J. J. O'Neill examined the properties around Hazelton in 1917. George Hanson mapped Zymoetz River area between Hudson Bay Mountain on the east and Skeena River on the west in 1925, and during the same season R. H. B. Jones examined the geology and some of the mineral deposits on Hudson Bay Mountain. F. A. Kerr examined mineral properties between Prince Rupert and Prince George in 1936, and also a few deposits at Hazelton and Smithers. J. E. Armstrong commenced the geological mapping of the south part of the west half of Hazelton map-area in 1938.

In the neighbourhood of Hazelton the average magnetic declination is close to 29 degrees, and near Smithers it is 28 degrees 30 minutes east of true north. These figures have been used in correcting for true north throughout this report. The assays given in the descriptions, unless otherwise specified are of samples collected by the writer and assayed by the Ore Testing Laboratories, Department of Mines and Resources, Ottawa.

The following student assistants from the University of British Columbia rendered efficient aid with the field work: J. W. Hoadley and W. R. Bacon (1937 season), and W. J. G. Clarke, H. W. Little, and R. B. Toombs (1938 season).

A number of the mining properties described are meritorious. The Victory, Mamie, and Duthie properties combined might furnish sufficient low-grade gold-arsenopyrite ore to warrant construction of a gold milling plant. The high-grade gold ore found on the Glacier Gulch Gold group should encourage thorough prospecting in that vicinity. Considerable zinc ore is indicated at the Silver Creek property and the tungsten content of the Black Prince and Red Rose properties is worthy of investigation. On Nine Mile Mountain, the Lead King and Sunrise properties could furnish considerable silver-lead-zinc ore containing bismuth and antimony. There is a strong vein system at the Silver Standard mine, and room for considerable development work with the prospect of finding both gold-arsenopyrite ore and silver-lead-zinc ore. The low-grade copper ore still remaining in the Rocher Déboulé mine may prove attractive at some future time when copper is in more demand. There is, in addition, much territory north of Hazelton only partly prospected.

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Map 2098: Zymoetz River Area; issued by Geol. Surv., Canada, 1926.

Map 1731: Mineral Areas in the Vicinity of Hazelton; issued by Geol. Surv., Canada, 1919.

Map 1732: Principal Veins on Mining Properties, Head of Juniper Creek, Rocher Déboulé Range; issued by Geol. Surv., Canada, 1919.

Map 1733: Principal Veins at the Silver Standard Mine; issued by Geol. Surv., Canada, 1919.

Map 449A: Hazelton Sheet, West Half (topography only); issued by Bureau of Geology and Topography, 1938.

Map 368A: Smithers Sheet, West Half (topography only); issued by Bureau of Geology and Topography, 1938.

Map 278A: Prince Rupert Sheet; issued by Geol. Surv., Canada, 1933.

PHYSICAL FEATURES

Hazelton and Smithers areas are characterized by isolated groups of rugged mountains that rise to elevations exceeding 8,000 feet, and are separated by prominent valleys whose floors range from 1,000 to 3,000 feet in elevation. Small glaciers occupy cirques on the north and east sides of the highest peaks, and the streams springing from them are deeply encised. Alpine glaciation has produced many knife-edge ridges and serrated peaks above elevations of 6,000 feet, but the slopes into the main valleys below 5,000 feet have undergone little change since they were smoothed by continental glaciation, except where the mountain streams have cut deep gorges. The wide valley occupied by Bulkley and Kispiox Rivers is a particularly prominent topographic feature. It ranges from 2 to 10 miles in width, and extends in a northwest direction for 100 miles across the Smithers and Hazelton map-areas. Rocher Déboulé, Hudson Bay, and other unnamed mountains lying west of this valley constitute

the Bulkley Mountain system. Bulkley Mountains pass into the Coast Range Mountains on the west. The mountains lying east of Bulkley River and between Skeena and Babine Rivers north of Hazelton are named Babine Mountains. They pass into the Interior Plateau on approaching Babine Lake.

The Rocher Déboulé Range, south of Hazelton, is 20 miles long from north to south and 14 miles wide. Several of its peaks surpass 8,000 feet in altitude, and one peak is 8,200 feet high. There are numerous small glaciers on the east sides of the higher peaks. These mountains are bordered on the north and east by Bulkley River Valley, on the northwest by Skeena River, and by the valley of Kitseguecla Creek, a north-flowing tributory of the Skeena, on the west and southwest. The elevation at the South Hazelton station is 985 feet, so that the maximum relief exceeds 7,000 feet. The west slope of the mountain is drained by Kitseguecla and Juniper Creeks and their tributaries. The north and east slopes are drained by Station (Mission), Mudflat, Porphyry, Straw, Chink, Corya, and John Brown Creeks, all of which flow into Bulkley River. Sheedy Creek, which also runs easterly to the Bulkley, drains a valley 1 mile wide that separates Hudson Bay Mountains on the south from Rocher Déboulé Mountains.

Hudson Bay Mountains are 12 miles broad from east to west and extend for 15 miles in a northwest direction. The main peak, 12 miles northwest of Smithers, rises to 8,600 feet, and several of the nearby peaks exceed 8,000 feet. The elevation at Smithers is 1,627 feet and the maximum relief is over 7,000 feet when measured from the level of Bulkley River. On the east side of the highest peak a glacier 1½ miles in length has cut a deep valley called Glacier Gulch. Another glacier, also 1½ miles in length, runs down to the northeast from the main peak into the valley of Toboggan Creek. Toboggan, Glacier Gulch, Simpson, and numerous smaller creeks head on the east slope of Hudson Bay Mountains and drain easterly into Bulkley River. Silvern, Henderson, and other creeks on the west and southwest slopes of the mountain empty into Aldrich, Dennis, and McDonell Lakes, which lie on a valley floor ranging from 2,600 to 2,800 feet in elevation. These lakes form the headwaters of Zymoetz River, which drains southwest to join Skeena River at Copper City. Silvern and Toboggan Creeks have cut deep valleys, which nearly encircle the highest group of peaks. The headwaters of Silvern and Toboggan Creeks are separated between Silver and Schufer Lakes by a pass whose elevation is 5,100 feet.

Nine Mile Mountain, 5 miles northeast of Hazelton, has a lateral extent from east to west of 12 miles and from north to south, 8 miles. It is bounded on the north by the deeply cut valley of Shegunia River, which enters the Skeena near Kispiox. Bulkley River Valley lies to the south and Suskwa River Valley is on the southeast. This mountain has a subdued profile with the highest point, at elevation 5,745 feet, gently rounded. Precipitous slopes are confined to the north side of the mountain where glacial cirques, now free of ice, form a series of steep-walled basins. Glen Mountain, lying between Nine Mile Mountain and Skeena River, and Four Mile Mountain, between Nine Mile and Bulkley River, are also

gently rounded. They are small mountains having maximum altitudes of about 2,200 feet. The mountains lying north of Shegunia River are much higher than Nine Mile Mountain and foster many small glaciers.

Skeena River is a wide, swift, turbid stream scarcely navigable for boats, although river steamers did ascend as far as Hazelton prior to completion of the railway to South Hazelton late in 1912. The river flows in a southerly direction across the west half of Hazelton map-area to its junction with Bulkley River, then swings southwest for 12 miles as far as Skeena Crossing, and then westerly on its trip to the sea. Bulkley River flows northwest for 35 miles from Smithers and then west for 8 miles to where it joins the Skeena. Hazelton is on the north side of Bulkley River where it empties into Skeena River. Kispiox River runs southeast to join the Skeena 6 miles north of Hazelton, and Babine River flows into the Skeena from the east 30 miles north of Hazelton. All these rivers are swift and unfit for canoes due to the numerous rapids and steep-walled rock canyons.

Where spared by fire the valleys and mountain slopes up to elevations of 4,500 feet are well forested with one or more of the following types of trees: hemlock, spruce, cedar, balsam, poplar, and jack pine. Large numbers of cedar poles are shipped each year from South Hazelton and New Hazelton, but cedar trees are scarce near Smithers. The average rainfall in Bulkley Valley at Smithers is a little under 20 inches a year, but it is considerably more at Hazelton.

DESCRIPTIONS OF LODE DEPOSITS

Fortune Hill Claim (1)[1]

Reference: Ann. Rept., Minister of Mines, B.C., 1933, p. 97.

The Fortune Hill claim, owned by Lars Hagan of Hazelton, is on the west bank of Skeena River about 4 miles above the mouth of Kispiox River. The prospect workings are on the east side of a hill that drops steeply for about 500 feet to the river. The property is reached by a trail from Love's farm.

About 200 feet above the river a mineralized replacement zone is exposed by four open-cuts for 275 feet along the side of the hill. This zone ranges from 2 to 5 feet in width and follows the bedding of the enclosing sediments, which strike north and dip 30 degrees west into the hill. The wall-rocks are indurated sandstone composed of subangular grains of quartz and chert cemented by siderite with a little extremely fine argillaceous material. The replacement zone follows a bed in the sandstone that is unusually rich in siderite. The siderite is replaced by disseminated pyrite with minor amounts of pyrrhotite, arsenopyrite, chalcopyrite, and sphalerite. The replacement process was accompanied by the introduction of silica and the quartz and chert grains in the mineralized zone are largely recrystallized.

[1] This number appears on the accompanying index map (Figure 1) and indicates the approximate location of the property.

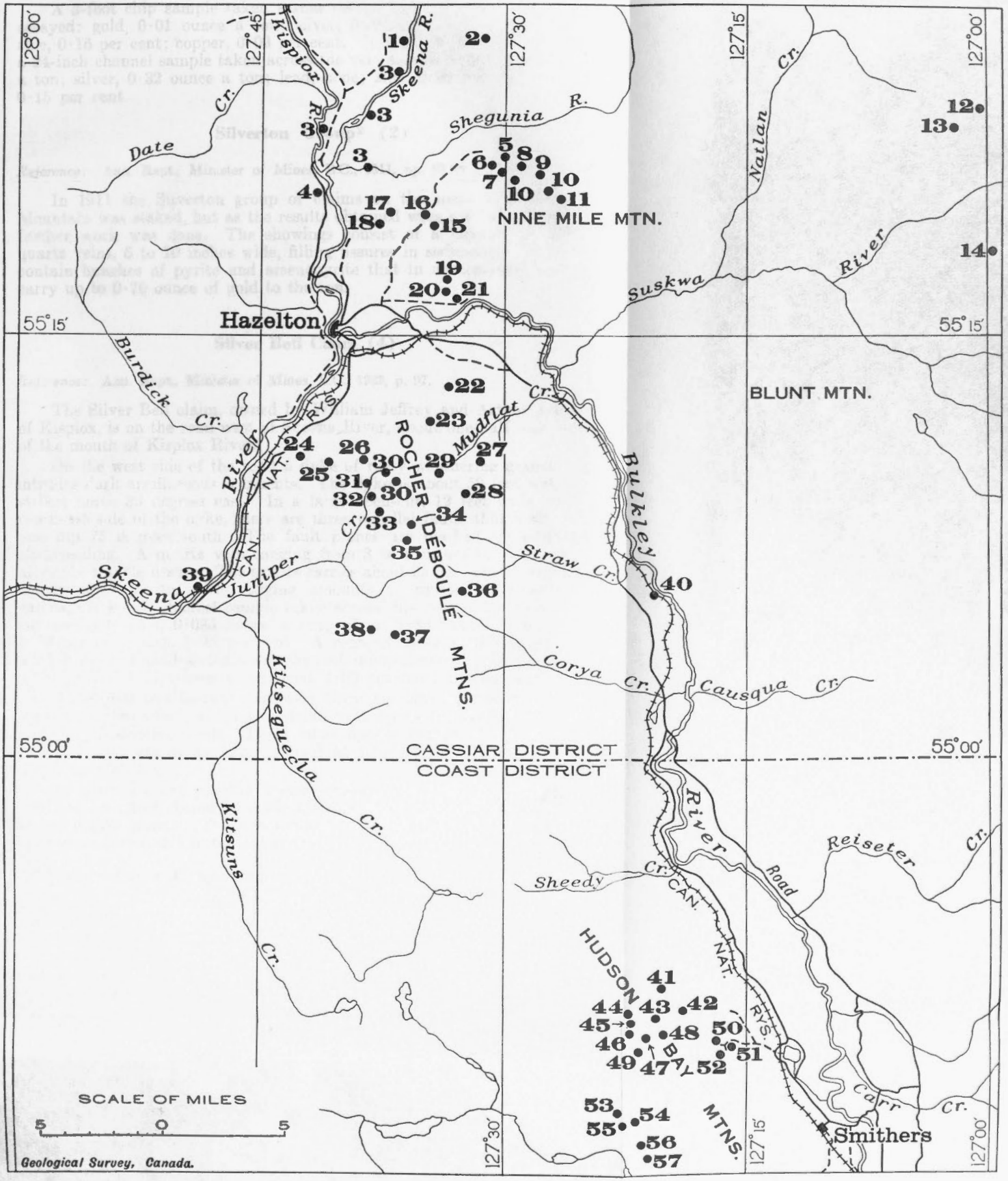

Figure 1. Index map showing positions of properties described. 1, Fortune Hill claim; 2, Silverton group; 3, Kispiox coal area; 4, Silver Bell claim; 5, Barber Bill group; 6, Silver Cup group; 7, Pole Star claim; 8, Sunrise group; 9, Lead King group; 10, Slocan group; 11, Silver Pick group; 12, O.K. group; 13, True Fissure group; 14, Higgins property; 15, American Boy group; 16, Robinson Lake marl; 17, Surprise group; 18, Silver Standard mine; 19, Babine group; 20, Erie group; 21 Comet group; 22, Daley West group; 23, Hecla claim; 24, Golden Wonder group; 25, Cap or Comeau group; 26, Hazelton View group; 27, Lone Star claim; 28, MacDonald property; 29, Black Prince group; 30, Highland Boy group; 31, Rocher Déboulé mine; 32, Great Ohio group; 33, Spaulding property; 34, Red Rose group; 35, Brunswick group; 36, Sultana group; 37, Brian Boru group; 38, Killarney group; 39, Skeena Crossing; 40, Seaton coal area; 41, Evelyn group; 42, Carroll property; 43, Rio Grande group; 44, Last Chance claim; 45, Mammoth claim; 46, Silver Creek group; 47, Josie claim; 48, Matuss claim; 49, Silver Lake group; 50, Glacier Gulch North Side group; 51, Lake Kathlyn coal mine; 52, Glacier Gulch Gold group; 53, Victory group; 54, Mamie group; 55, Coronado group; 56, Henderson group; 57, King Tut group.

Hazelton
Skeena
Kispiox
Babine
Bulkley
Nine Mile
Rocher Deboule
Mts.
Cassiar District
Coast District

A 3-foot chip sample taken across the mineral zone in the north pit assayed: gold, 0·01 ounce a ton; silver, 0·15 ounce a ton; lead, none; zinc, 0·16 per cent; copper, 0·09 per cent. In a pit 80 feet farther south, a 24-inch channel sample taken across the vein assayed: gold, 0·005 ounce a ton; silver, 0·32 ounce a ton; lead, none; zinc, 0·90 per cent; copper, 0·15 per cent.

Silverton Group[2] (2)

Reference: Ann. Rept., Minister of Mines, B.C., 1911, pp. 98-99.

In 1911 the Silverton group of claims on the south side of Utsun Mountain was staked, but as the results obtained were not encouraging no further work was done. The showings consist of a number of narrow quartz veins, 6 to 10 inches wide, filling fissures in sediments. The veins contain bunches of pyrite and arsenopyrite that in concentrated samples carry up to 0·70 ounce of gold to the ton.

Silver Bell Claim (4)

Reference: Ann. Rept., Minister of Mines, B.C., 1933, p. 97.

The Silver Bell claim, owned by William Jeffrey and Arthur Johnson of Kispiox, is on the road west of Skeena River, about one-half mile south of the mouth of Kispiox River.

On the west side of the road a dyke of rusty weathering granodiorite intrudes dark argillaceous sediments. The dyke is about 50 feet wide and strikes north 30 degrees east. In a large open-cut, 12 feet wide, on the southeast side of the dyke, there are three parallel faults that strike west and dip 75 degrees south. The fault planes are marked by horizontal slickensiding. A quartz vein ranging from 3 to 6 inches in width occurs along the middle fissure. The quartz carries about 25 per cent of sulphides, chiefly arsenopyrite, with varying amounts of pyrite, sphalerite, and galena. A 4-inch channel sample taken across this vein in the face of the cut assayed: gold, 0·095 ounce a ton; silver, 2·88 ounces a ton; lead, 3·78 per cent; zinc, 3·95 per cent. A representative sample taken from a 2-ton stack of hand-sorted ore on the rock dump assayed: gold, 0·09 ounce a ton; silver, 1·77 ounces a ton; lead, 1·99 per cent; zinc, 3·50 per cent.

About 100 feet farther southwest there are two other 6-inch quartz veins 20 inches apart, which also strike west across the granodiorite dyke and dip 75 degrees south. These veins appear barren in the small pit in which they are exposed, but should be stripped and examined farther along their strike.

As there are five parallel fissures crossing the dyke in a distance of 100 feet, an effort should be made to trace them west into the sediments in the higher ground. There is a possibility that vein-forming conditions were more favourable in the sediments.

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[2] Examined by J. E. Armstrong.

Barber Bill Group (5)

References: Ann. Repts., Minister of Mines, B.C.: 1910, p. 87; 1917, p. 107; 1928, p. 155.

The Barber Bill claims are on the east side of Silver Cup Basin on the north side of Nine Mile Mountain. Silver Cup Basin is reached by way of the Nine Mile Mountain road, which ascends to the lower end of the basin at elevation 3,400 feet by a series of switchbacks. From the road a good trail about 1 mile in length leads up to the workings, which are situated in the timber. W. S. Harris and associates carried out a little development work there in 1928.

At elevation 4,100 feet a vein is exposed by stripping and by open-cuts for about 375 feet along the steep east slope of the basin. It is enclosed in fine-grained, bedded greywacke immediately north of the northwest end of the granodiorite stock that intrudes the sediments on this side of the mountain. The vein strikes north, dips from 18 to 30 degrees east into the mountain, and ranges from 4 inches to 4 feet in width. It lies along a fault that follows closely the bedding of the tuffs. The vein is essentially a replacement of the tuff along both sides of the fissure by very finely crystalline jamesonite, sphalerite, galena, and arsenopyrite. There is a little vein quartz and fine pyrite associated with these sulphides along the original fissure.

Midway along its strike the vein is explored by a 45-foot adit with a shallow winze, now water filled at the face. In the adit the vein has an average width of 2 feet and where it is joined by a divergent fracture there is a mineralized width of 4 feet for a short distance. A 24-inch channel sample taken across the vein near the winze assayed: gold, 0·045 ounce a ton; silver, 14·89 ounces a ton; lead, 5·67 per cent; zinc, 12·50 per cent; antimony, 2·22 per cent; arsenic, 8·15 per cent.

In a trench 125 feet north of the adit, the vein is 1 foot wide and consists of schistose tuff replaced by jamesonite, which is now greatly oxidized. An 11-inch channel sample taken here across the vein assayed: gold, 0·03 ounce a ton; silver, 9·91 ounces a ton; lead, 5·88 per cent; zinc, nil; antimony, 1·91 per cent.

In a rock cut 150 feet south of the adit, the vein fissure is strong but carries very little vein filling, and the wall-rocks are very sparsely mineralized. The granodiorite stock lies between 50 and 75 feet south of this pit, but the actual contact is talus covered.

Silver Cup Group (6)

References: Geol. Surv., Canada, Sum. Repts.: 1909, p. 65; 1910, p. 97; Mem. 110, 1919, p. 34. Ann. Repts., Minister of Mines, B.C.: 1909, p. 84; 1910, p. 86; 1911, p. 105; 1912, p. 113; 1914, pp. 201-204; 1915, p. 76; 1920, p. 84; 1925, p. 134; 1926, p. 126; 1927, p. 130; 1928, p. 152; 1929, p. 156.

The Silver Cup group of four Crown granted claims, the Silver Cup, Silver Dollar, Duke, and Duchess, is on the north side of Nine Mile Mountain and blankets the west side of a steep-walled cirque known as Silver Cup Basin. The property is the most westerly of those on the north side of the mountain. It is 8 miles north of New Hazelton station or 13

miles by way of the Nine Mile Mountain road to the lower end of the Silver Cup Basin at elevation 3,400 feet. The mine workings are on the steep southwest rim of the basin between elevations of 4,600 and 5,000 feet (*See* Plate I). The mill, now dismantled, is below the basin in the timber at an elevation of 3,000 feet.

The claims were staked in 1909 by Messrs. Harris and Trainer. Silver Cup Mines, Limited, was organized, and in 1910 a 200-foot adit was driven on the main vein at elevation 4,800 feet, a 90-foot adit at elevation 4,700 feet, and a 100-foot adit at elevation 4,575 feet. The latter is now the main adit level. Two other adits were started in the slide rock, but never got far enough to strike the vein and soon caved in. Two short adits were also driven on the Duchess claim at elevations of 3,750 feet and 4,135 feet, respectively. On the Duke claim to the west, an adit drift 150 feet in length was driven, and other small veins farther up the ridge were prospected by open-cuts and a 20-foot adit. In 1914 the mine was leased by Clothier Brothers who shipped 23 tons of selected ore that year and 70 tons in 1915. Work was recommenced in 1925 by W. S. Harris and a little further ore was shipped. In 1927, Duke Mining Company, Limited, built a 3,200-foot aerial tram from the main mine level and started construction of a 50-ton daily capacity mill employing Macintosh flotation cells. Development work was pushed in 1928 and 256 tons of hand-sorted ore was shipped during the year. The mill was completed and put into operation in May 1929 by Silver Cup (Hazelton) Mining Company, Limited. Difficulties were encountered in treating the ore, but finally a flow sheet was worked out that recovered a single concentrate containing 92 per cent of the silver, 90 per cent of the lead, and from 40 to 45 per cent of the zinc content of the ore. The capacity of the mill was found to be in excess of the productive power of the mine and it soon became evident that no profit could be earned under the existing conditions. Mining operations ceased in November and the mill shut down on December 7, 1929. Approximately 5,710 tons of ore were treated and 571 tons of concentrates were made.

The Minister of Mines, British Columbia, report for 1929 gives the average grade of concentrates shipped for the months of September and October of that year as: silver, 126·40 ounces a ton; lead, 25·60 per cent; zinc, 16·90 per cent; and for the month of November and part of December, as: silver, 152·60 ounces a ton; lead, 27·60 per cent; zinc, 16·00 per cent. As a check on the precious metals and antimony content of the concentrates shipped, the writer collected two samples in 1937 from a small amount of concentrates still remaining in the bins at the mill. These samples gave an average assay as follows: gold, 0·013 ounce a ton; silver, 79·07 ounces a ton; platinum, nil; lead, 21·56 per cent; zinc, 18·21 per cent; arsenic, 5·22 per cent; antimony, 6·16 per cent; sulphur, 19·81 per cent; bismuth a trace; tin, none; cobalt, 0·06 per cent; copper (not tested).

The Silver Cup quartz vein is exposed on the precipitous rim of the basin between elevations of 4,600 feet and 5,000 feet. It strikes north 30 degrees east and dips 75 degrees southeast. The vein occurs along a fault marked by horizontal slickensides in bedded sediments.

The quartz gangue carries abundant sphalerite, galena, jamesonite, tetrahedrite, and pyrite. In some places two or more parallel fractures

from 1 to 3 feet apart have increased the width of the vein, the enclosed, brecciated rock being replaced by a little quartz with sulphides. The sediments are chiefly thick-bedded, impure sandstones, in places tuffaceous, with interbedded, finely laminated argillites. On the west side of the vein the sediments strike northeast and dip from 10 to 15 degrees northwest. A short distance east of the vein the sediments have a similar strike but dip 15 degrees southeast, so that the vein is located on a fault along the crest of an anticlinal fold. The west tip of the granodiorite stock, which intrudes the sediments for 3 miles along the north side of the mountain, approaches to within 1,000 feet of the vein. The intrusive is exposed in the east wall of the Silver Cup Basin, but its westerly extension is covered by talus. A number of granodiorite dykes, evidently apophyses from the main stock, are exposed in the workings. These dykes were intruded prior to mineralization, as they are faulted along the vein fissure. The vein is believed to have been deposited from mineralizing solutions arising from an underlying body of the granodiorite.

The main adit, at elevation 4,575 feet, is 730 feet long. The vein is intersected 170 feet from the portal and has been drifted along in a south-westerly direction for 425 feet. For the first 130 feet the vein ranges from 4 to 24 inches in width, with an average width of 12 inches. For the next 90 feet the vein has been stoped out, and a little farther along there is a 40-foot length stoped out for 10 feet above the roof level. At 340 feet from the portal the main raise leads up to the next level. The vein width averages 6 inches there, but 75 feet farther south it splits into three diverging parts, the centre branch of which is followed by the drift for 80 feet south to where the vein flattens and disappears at a short crosscut to the east. The adit ends roughly 100 feet farther south in a dyke-like body of granodiorite.

A 4-inch channel sample taken across the vein 170 feet from the portal of the adit, at the intersection of the main crosscut with the adit drift, assayed: gold, 0·02 ounce a ton; silver, 27·10 ounces a ton; lead, 3·37 per cent, zinc, 3·58 per cent; antimony, 2·13 per cent. An 11-inch channel sample, taken across the vein 60 feet farther northeast, assayed: gold, 0·01 ounce a ton; silver, 1·05 ounces a ton; lead, 0·21 per cent; zinc, 0·15 per cent; antimony, nil. A 24-inch channel sample, taken across the vein just north of the main stope or 225 feet from the portal of the adit, assayed: gold, 0·015 ounce a ton; silver, 0·78 ounce a ton; lead, 1·22 per cent; zinc, 3·10 per cent; antimony, 0·92 per cent.

The next higher adit, at elevation 4,700 feet, is 560 feet long and for most of its length follows the vein. Between 50 and 275 feet from the portal the vein is stoped out above this level. Farther south the vein ranges from 3 to 6 inches in width for about 250 feet and then pinches out near the face of the adit. Granodiorite shows in the face and on both walls 65 feet north of the face of the adit. This adit is connected with the main adit and the upper adit by a raise that comes up at a point 310 feet from the portal. A 4-inch channel sample, taken across the vein 15 feet south of the raise, assayed: gold, 0·05 ounce a ton; silver, 47·72 ounces a ton; lead, 10·63 per cent; zinc, 8·64 per cent; antimony, 1·90 per cent. This section of the vein carries abundant sulphides, and there is a parallel 2-inch

vein of similar ore 18 inches to the east. The 4-inch seam is typical of the better parts of the main vein south of the raise.

The upper adit, at elevation 4,800 feet, was not examined as the entrance was ice filled.

There is a vein in a 20-foot trench at elevation 5,030 feet, about 1,000 feet south of the portal of the main adit. This may be the Silver Cup vein, but there is a possibility that it is a distinct vein as it is 200 feet south of the ends of the adit workings. The vein strikes north 30 degrees east and dips 70 degrees east. It ranges from 3 to 8 inches in width and consists of quartz and carbonate gangue with considerable jamesonite and sphalerite. An 8-inch channel sample taken across the vein assayed: gold, 0·015 ounce a ton; silver, 35·40 ounces a ton; lead, 13·51 per cent; zinc, 1·27 per cent; antimony, 2·80 per cent. Further search should be made to the south for a continuation of this vein.

At elevation 4,130 feet, or 850 feet down the talus slide from the main adit, there is a 46-foot adit on the Duchess claim. It is driven south in flat-lying argillites, which are cut by a 3-foot dyke of granodiorite 20 feet from the portal. The small calcite stringer investigated is unmineralized.

At elevation 3,750 feet, an exploratory adit 45 feet long follows a 12-inch quartz vein for about 20 feet to where the vein is cut off by a fault. The quartz gangue carries up to 30 per cent of galena, sphalerite, and pyrite. A representative sample taken across the vein a few feet from the portal assayed: gold, 0·025 ounce a ton; silver, 9·17 ounces a ton; lead, 1·80 per cent; zinc, 6·50 per cent.

Pole Star Claim (7)

The Pole Star claim is between the Silver Cup mine and the peak of the mountain on the south side of Silver Cup Basin. The claim was staked by Joe Miller in 1909, and for a number of years small veins were prospected by open-cuts and by stripping on the gently rising ground between elevations of 5,100 and 5,400 feet above Silver Cup Basin.

The main vein is exposed for about 100 feet along the face of the bluff at the top of the basin. It ranges from 6 to 24 inches in width, strikes north 30 degrees west, and dips 15 degrees southwest. The vein is well mineralized with galena and sphalerite and contains a little tetrahedrite and arsenopyrite. It is prospected by a 15-foot adit and a trench 60 feet long and 8 feet deep. About 10 tons of ore from these operations has been stockpiled. The enclosing sediments, interbedded greywacke, sandstones, and argillites, strike south 30 degrees west and dip 15 degrees east.

Sunrise Group (8)

References: Geol. Surv., Canada, Sum. Repts.: 1909, p. 66; 1910, p. 97; Mem. 110, 1919, p. 34. Ann. Repts., Minister of Mines, B.C.: 1909, p. 84; 1911, pp. 79 and 104; 1914, p. 204; 1915, p. 76; 1918, p. 117; 1919, p. 102; 1920, p. 86; 1922, p. 98; 1923, p. 106; 1924, p. 94; 1926, p. 126; 1927, p. 131.

The Sunrise group, of five mining claims, is on the north slope of Nine Mile Mountain, 8 miles northeast of New Hazelton station. The claims are bounded on the east by the Lead King and Slocan groups. The

Silver Cup property lies about 1 mile west. The prospect is reached from New Hazelton by way of the Nine Mile Mountain road, over a distance of 13 miles to Silver Cup Basin at elevation 3,400 feet and an additional 2 miles east by a good pack-horse trail to the Sunrise cabin at elevation 4,250 feet. The showings are on the mountain slope above the cabin, between elevations of 4,800 and 5,200 feet (*See* Figure 2). Quartz veins carrying abundant jamesonite, galena, and sphalerite were discovered here in 1909. Hazelton Sunrise Mines, Limited, was organized in 1911 and carried out some development work. In 1915, a shipment of 74 tons of hand-sorted ore, mostly solid sulphides, was made to the smelter, but results are not recorded. J. Errington secured an option in 1918 and did some surface stripping, and American Smelting and Refining Company carried out further development work in 1920. Trethewey Brothers carried on work for several seasons beginning in 1923, and were responsible for driving the main crosscut adit 400 feet. The work was resumed in 1927 by Hazelton Sunrise Mines, Limited, the main adit being extended to a total length of 750 feet with a 60-foot raise from the face driven up at 45 degrees. During the 1937 season this company carried out a program of surface trenching and exposed several new veins.

The veins occur in coarsely crystalline, grey granodiorite in intersecting fault fissures along which there has been minor displacement. The granodiorite forms a stock 3 miles long, from east to west, and 3,000 feet wide. It intrudes sediments along the north side of the mountain. The veins are in a disturbed zone that measures 700 feet in width from north to south and 1,000 feet in length from west to east across the Sunrise property, and extends an additional 1,500 feet east across the adjoining Lead King property. The main fracture zone lies between elevations of 4,700 and 5,200 feet, and its north boundary is about 500 feet south of the sedimentary contact. The continuity of the outcrop of the vein occurrences on the Sunrise group and on the neighbouring Lead King group is interrupted by a steep-walled glacial cirque measuring about 900 feet across from wall to wall. The floor of this basin is talus covered, but veins outcrop on both the east and west walls. The dividing line between the two properties lies near the centre of the basin.

There are two intersecting sets of veins on the Sunrise property. One set strikes northeast and dips from 30 to 50 degrees southeast. The other set strikes east and dips from 10 to 40 degrees south. The veins range from 100 to 500 feet in length and from 3 inches to 4 feet in width. They frequently occur in parallel groups or may be arranged *en échelon*. Many of the veins consist of almost solid sulphide, but there is commonly an abundance of quartz gangue. The metallic minerals present, in order of their abundance, are: jamesonite, sphalerite, galena, cosalite, pyrite, arsenopyrite, argentite, and tetrahedrite. The ore contains appreciable amounts of silver, lead, zinc, antimony, and bismuth.

In an open-cut 20 feet above the portal of the main adit there are four parallel fissures spaced at intervals of 3 feet. They strike northeast and dip 50 degrees southeast. Small, quartz-sulphide, lens-like veins ranging from 2 to 6 inches in width occur along these fissures. The ore consists of massive sphalerite and jamesonite with a little galena and minor quartz gangue. The granodiorite wall-rock is altered near these veins

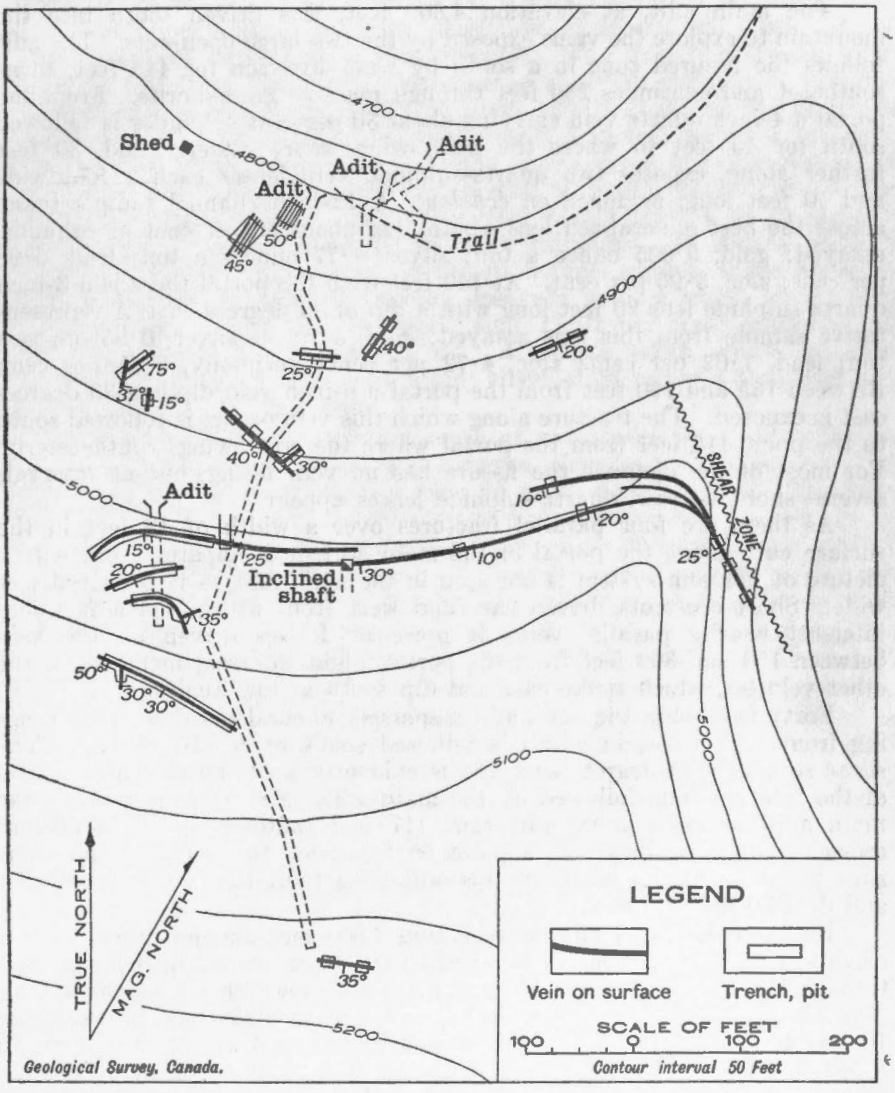


Figure 2. Plan of part of Sunrise group.

and is replaced in a number of places by small veinlets of quartz, sphalerite, jamesonite, and galena. At elevation 4,840 feet the four fault fissures are exposed in a second large open-cut, but there three fissures are mostly barren.

The main adit, at elevation 4,800 feet, was driven south into the mountain to explore the veins exposed by the two large open-cuts. The adit follows the fissured zone in a south by west direction for 445 feet, turns southeast and continues 280 feet through massive granodiorite. From the portal a 4-inch quartz vein carrying about 30 per cent sulphides is followed south for 40 feet to where the adit swings more easterly and, 30 feet farther along, exposes two quartz-sulphide vein lenses each 1 foot wide and 10 feet long, arranged *en échelon*. A 12-inch channel sample taken across the best mineralized lens, containing about 60 per cent of sulphide, assayed: gold, 0·005 ounce a ton; silver, 4·77 ounces a ton; lead, 5·98 per cent; zinc, 3·96 per cent. At 140 feet from the portal there is a 3-inch quartz-sulphide lens 20 feet long with a dip of 30 degrees east. A representative sample from this lens assayed: gold, a trace; silver, 0·85 ounce a ton; lead, 1·02 per cent; zinc, 4·72 per cent; antimony, 0·51 per cent. Between 165 and 190 feet from the portal a 6-inch vein dipping 30 degrees east is exposed. The fracture along which this vein occurs is followed south to the point 445 feet from the portal where the adit swings southeasterly. For most of the distance the fissure has no vein filling, but at intervals several short, narrow, quartz-sulphide lenses appear.

As there are four parallel fractures over a width of 12 feet in the surface cuts above the portal of the main adit, it is apparent that a true picture of the vein system is not seen in the main adit as it is only 6 feet wide. Short crosscuts driven east and west from within the adit would intersect nearby parallel veins if present. Raises driven on the vein between 150 and 300 feet from the portal might intersect members of the other vein set, which strike east and dip south at low angles.

Forty feet below the main adit a sparsely mineralized shear zone ranging from 1 to 3 feet in width is followed south by a 32-foot adit. The shear zone dips 45 degrees east and is evidently a downward continuation of the fracture zone followed by the main adit. Sixty-five feet below the main adit an exploratory adit runs 117 feet southwest, with a 50-foot crosscut to the southeast at a point 55 feet from the portal. The shear zone is cut off at the portal of this adit by a fault that strikes northeast and dips 30 degrees west.

Between the main adit at elevation 4,800 feet and an upper adit at elevation 4,985 feet, eight or ten veins have been opened up by stripping through a light overburden. Most of these are shown on the accompanying plan (Figure 2). One of these veins, at elevation 4,950 feet, is traced for 70 feet by three pits. It ranges from 6 inches in width at either end to 3 feet in width at the central pit. In the east pit it is joined by a cross vein ranging from 4 to 8 inches in width. The main vein strikes southeast and dips 40 degrees southwest, and the cross vein strikes northeast and dips 30 degrees southeast. The quartz gangue of both veins is abundantly mineralized with sulphides. A 36-inch channel sample, taken across the vein in the centre pit, assayed: gold, nil; silver, 1·10 ounces a ton; lead, 2·96 per cent; zinc, 0·40 per cent. In a pit 100 feet farther west there is

a 4-inch seam of solid sulphide, largely of finely crystalline galena and jamesonite with minor sphalerite. A piece of this ore weighing about 4 pounds assayed: gold, 0·01 ounce a ton; silver, 99·13 ounces a ton; lead, 37·58 per cent; zinc, 5·59 per cent; antimony, 0·54 per cent.

The upper adit, at elevation 4,985 feet, is driven due south 110 feet, and intersects two veins in this distance. The first is a 3-inch quartz vein 55 feet from the portal, which carries about 10 per cent of sulphides. It strikes east and dips 28 degrees south and is doubtless the downward continuation of the strong vein that outcrops 25 feet south of the portal at elevation 5,000 feet. A branch vein comes in on the east wall of the adit near the 3-inch vein and is followed to within 15 feet of the face, where it enters the west wall. This vein ranges from 4 to 12 inches in width and is composed of almost solid sulphides. It strikes north by east and dips 65 degrees east. A 6-inch channel sample, taken across the latter vein 65 feet from the portal, assayed: gold, a trace; silver, 33·27 ounces a ton; lead, 13·74 per cent; zinc, 17·02 per cent; antimony, nil; arsenic, 1·35 per cent; bismuth, nil. A sample taken across the 3-inch vein assayed: gold, 0·05 ounce a ton; silver, 0·54 ounce a ton; lead, 0·31 per cent; zinc, 0·81 per cent.

On the surface immediately south of and above the upper adit, four strong veins have been trenched between elevations of 5,000 and 5,075 feet. They strike east and dip from 15 to 35 degrees south. The larger of these outcrops 15 feet above the portal and has been traced for 250 feet. In the main trench it ranges from 12 to 18 inches wide and the quartz gangue is well mineralized. A 12-inch channel sample taken across this vein above the adit assayed: gold, 0·015 ounce a ton; silver, 22·76 ounces a ton; lead, 11·37 per cent; zinc, 14·37 per cent; antimony, 2·59 per cent; arsenic, 2·09 per cent. In a cut 75 feet southeast of the adit the vein consists of 3 feet of almost solid sulphides, chiefly jamesonite, sphalerite, and cosalite. A representative sample of a 1-ton pile of ore taken from the open-cut assayed: gold, 0·005 ounce a ton; silver, 45·35 ounces a ton; lead, 62·24 per cent; zinc, 11·93 per cent; antimony, 5·97 per cent; bismuth, 8·50 per cent; tin, 0·07 per cent; arsenic, 1·35 per cent; copper, 0·18 per cent.

The second vein, 40 feet farther south, is trenched for 60 feet. It is only 3 to 4 inches wide, but consists of 75 per cent sulphides. A representative sample assayed: gold, 0·01 ounce a ton; silver, 2·73 ounces a ton; zinc, 19·86 per cent; antimony, 2·31 per cent; arsenic, 3·05 per cent; lead, not tested.

The third vein, an additional 30 feet up the slope, is stripped for 50 feet and is joined by another vein striking northeast and dipping 35 degrees southeast, at the east end of the trench. The main vein has an average width of 12 inches, the branch vein ranges from 2 to 6 inches in width, and both are well mineralized.

The fourth vein is stripped for 135 feet, ranges from 3 to 18 inches in width, and has an average width of about 12 inches. It consists of white quartz carrying about 20 per cent of banded sulphides. A 14-inch channel sample taken across this vein midway along its outcrop assayed: gold, a

trace; silver, 27·21 ounces a ton; lead, 11·63 per cent; zinc, 2·91 per cent; antimony, 2·28 per cent; bismuth, 9·10 per cent; arsenic, 2·43 per cent.

A 40-foot shaft inclined at 30 degrees is sunk on a strong vein 185 feet east of the upper adit. The vein strikes east and dips from 10 to 30 degrees south into the mountain. It is exposed at intervals by trenches through the overburden, for 50 feet west and for 360 feet east from the shaft. The quartz gangue is well mineralized throughout. At the shaft the vein is 4 feet wide, but 30 feet east it narrows to 12 inches. In a pit 100 feet east of the shaft it is 6 inches wide, and in a pit 225 feet east it consists of 3 inches of solid sulphides. About 30 feet below the latter pit there is a parallel vein 7 inches wide that carries 40 per cent of the lead-zinc-antimony sulphides. This one joins the main vein 150 feet to the west below the nose of the ridge on the side of the cirque mentioned earlier. There are several other short parallel veins ranging from 2 to 3 inches wide on the nose of the ridge. In the pits on the steep wall of the cirque the main vein has an average width of 15 inches and carries abundant sulphides. One hundred feet down the slope the veins are hidden by talus.

Forty feet northeast of the main vein, on the nose of the ridge, there is a strong shear zone 10 feet wide. It strikes northwest and dips vertically. The sheared granodiorite is bleached and rusted and is cut by numerous, small, sparsely mineralized quartz stringers.

Shallow surface operations will yield small tonnages of high-grade silver-lead-zinc ore, from which an appreciable recovery of antimony and bismuth might be made.

Lead King Group (9)

References: Ann. Repts., Minister of Mines, B.C.: 1910, p. 86; 1911, p. 79; 1912, p. 113; 1914, p. 205; 1918, p. 227; 1923, p. 106. Geol. Surv., Canada, Sum. Rept. 1909, p. 66.

The Lead King mineral claims, owned by Joe Miller[1] of South Hazelton, are on the north slope of Nine Mile Mountain about 8 miles in a straight line northeast of New Hazelton station. The claims are bounded on the west by the Sunrise group and on the east by the Silver Pick group. They form a unit of the Slocan group, which blankets the top of Nine Mile Mountain on the south. The claims are reached by way of Nine Mile Mountain road, 13 miles long from South Hazelton station to Silver Cup Basin at elevation 3,400 feet, and an additional 3 miles along a good pack-horse trail to the Lead King cabin in a grassy meadow at elevation 4,075 feet. The cabin is at the foot of a glacial cirque. The veins outcrop on the steep mountain slope between elevations of 4,600 and 5,100 feet on the east side of the cirque (*See* Figure 3).

Although numerous, small, rich veins containing silver, lead, zinc, and antimony occur on this property, there is only one record of ore shipped, namely 5 tons taken out in 1909. The Hazelton Nine Mile Mining Company, Limited, held the property in 1912, but work was confined to a

[1]Joe Miller's death was recently reported.

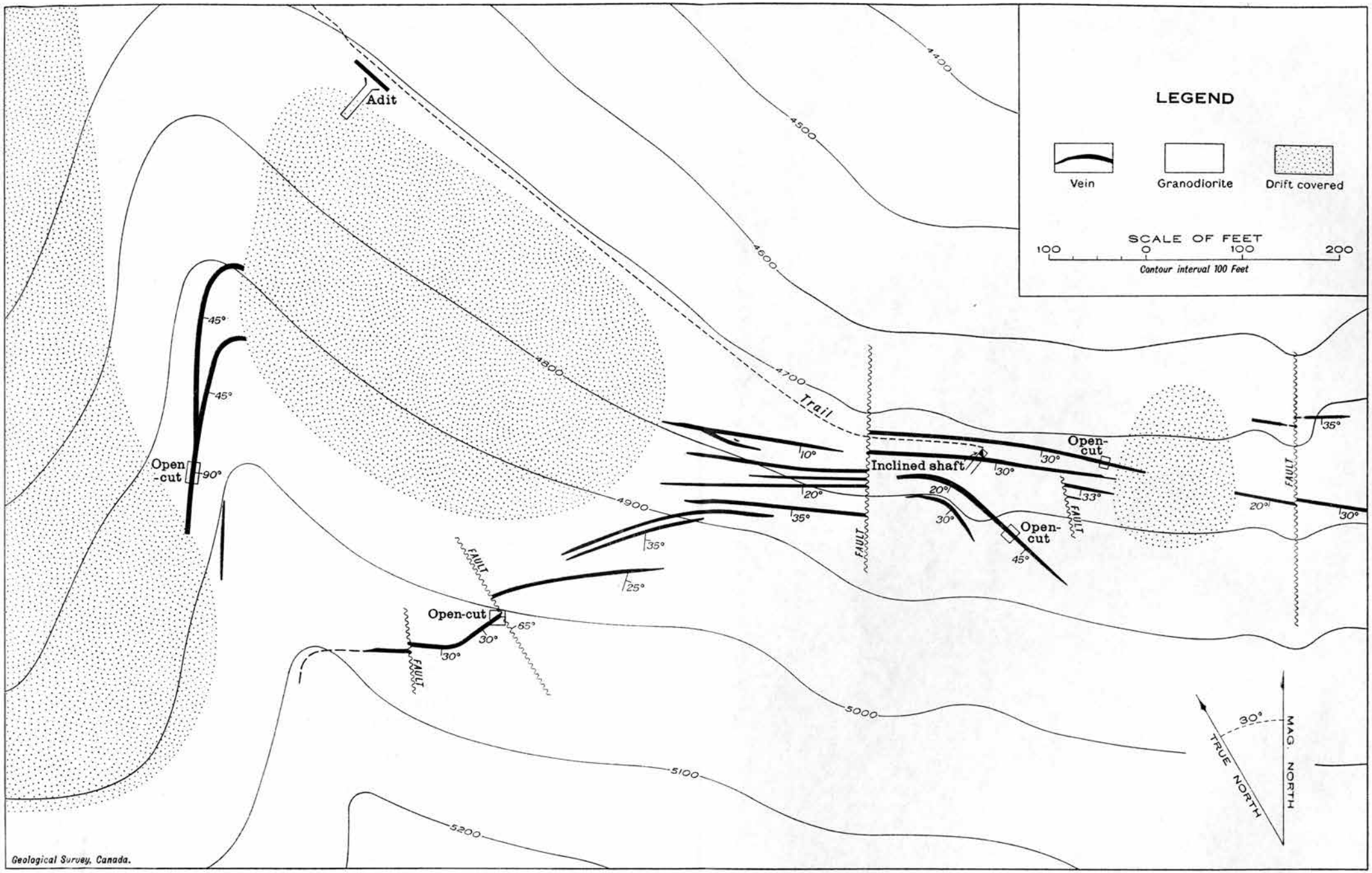
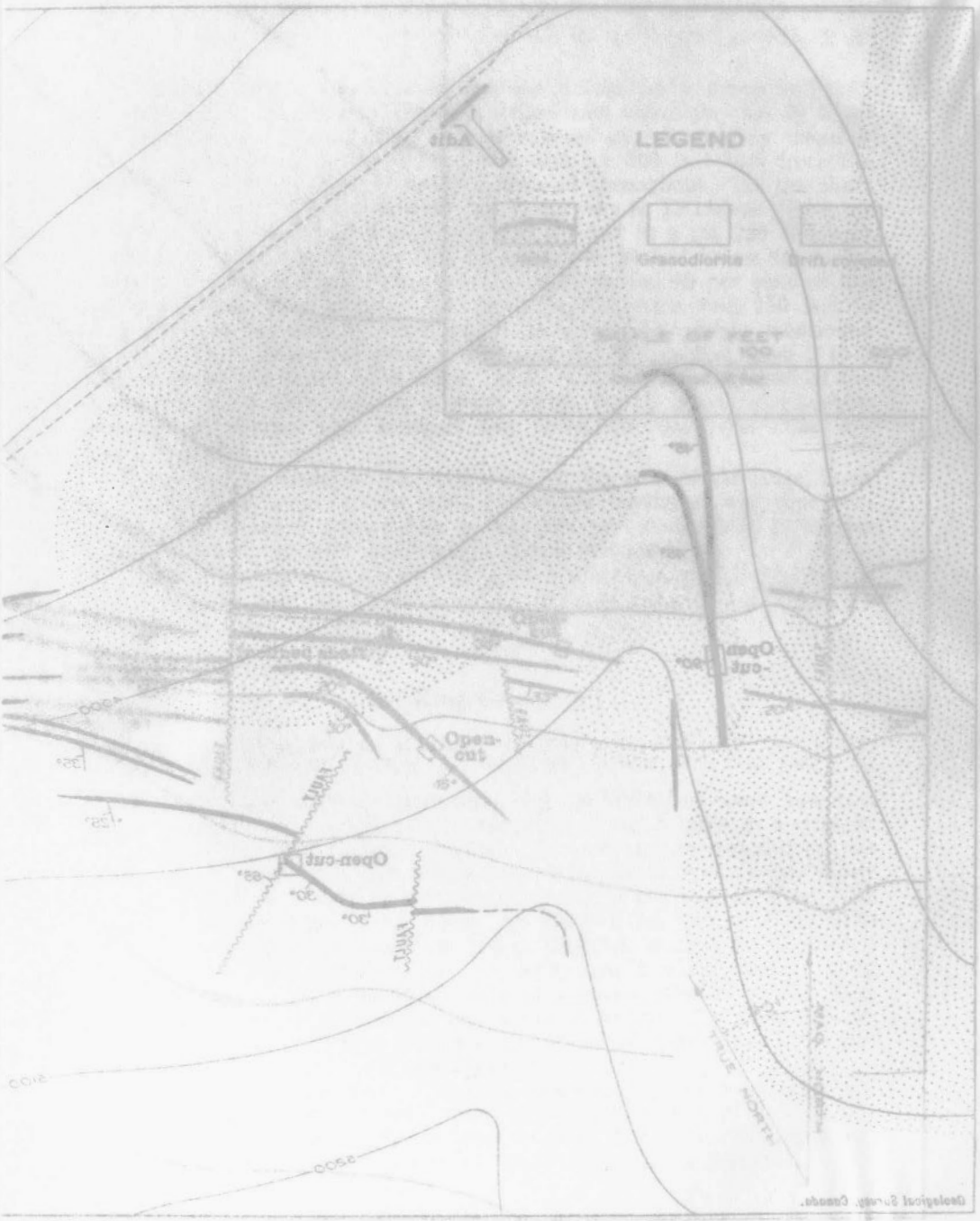


Figure 3. Plan of part of Lead King group.


LEGEND
Granodiorite
Open-cut
Open-cut

40-foot inclined shaft and a 30-foot drift. Little work has been done since that date aside from opening up of the veins along the surface by stripping and by open-cuts.

The veins occur along slickensided fault fissures in the granodiorite stock that intrudes the sediments along the north side of the mountain. They lie in a disturbed zone about 700 feet wide and possibly 2,500 feet long, which extends from the Lead King ground west across the Sunrise property. This zone is parallel with the line of contact of the granodiorite and intruded sediments, and its north border lies about 500 feet south of the contact within the intrusive. There are two distinct sets of vein fissures. One series strikes north and dips from 25 to 45 degrees east, and the other series strikes east and dips from 10 to 35 degrees south into the mountain. The fissures are offset a few feet by a number of normal faults that strike north and dip from 60 to 90 degrees east. The veins commonly range from 100 to 300 feet in length. Their average width is about 1 foot, but they are lenticular and range from 4 inches to 3 feet wide. They are commonly arranged *en échelon*. In some cases parallel veins lie only 6 feet apart and could be mined at the same time. The veins are mostly of quartz heavily mineralized with jamesonite, sphalerite, cosalite, and galena, with some argentite and tetrahedrite. There are, in addition, sheared zones in which the granodiorite is altered and replaced by fine veinlets of quartz, galena, sphalerite, and jamesonite.

At elevation 4,700 feet, about 100 feet east of a ridge marking the east side of a cirque, there is an open-cut and a 43-foot adit. A zone of sheared granodiorite carrying about 10 per cent of sphalerite and galena was stripped at the portal and 5 tons of ore is stockpiled there. No veins were cut in the adit. A representative sample of the ore assayed: gold, nil; silver, 37·97 ounces a ton; lead, 23·86 per cent; zinc, 29·50 per cent; antimony, 0·76 per cent.

About 725 feet farther east at the same elevation, an inclined shaft, now water filled, is sunk for about 40 feet on an 18-inch quartz vein. This vein is exposed at intervals for 200 feet along its strike, and ranges from 6 inches wide at both ends to 20 inches wide near its centre. A parallel vein lies from 10 to 15 feet below the shaft and is exposed at intervals, mostly by natural agencies, for 250 feet along its strike. Both veins strike east and dip 30 degrees south into the mountain. Two other veins outcrop at 50 and 70 feet, respectively, above the inclined shaft, and others are exposed in a small ravine 325 feet east of the shaft. All these veins carry an abundance of jamesonite and sphalerite and some cosalite, galena, and arsenopyrite in a quartz gangue. An 18-inch channel sample taken across the vein in the mouth of the inclined shaft assayed: gold, a trace; silver, 9·15 ounces a ton; lead, 6·47 per cent; zinc, 17·11 per cent; antimony, 2·63 per cent; arsenic, 2·43 per cent.

At 120 feet west of the inclined shaft the veins are cut off by a fault that strikes north and dips 60 degrees east. On the west side of this fault, nine veins outcrop along the precipitous slope between elevations of 4,750 and 5,100 feet. Most of these veins are exposed by natural agencies. One vein, exposed between elevations of 4,940 and 5,075 feet, is cut into three parts by two faults that strike north and dip east. The middle segment is 100 feet long and ranges from 18 to 24 inches in width. There is a

12-foot open-cut at its east end at elevation 5,000 feet. The west segment is offset only a few feet. It is 40 feet long and ranges from 6 to 12 inches in width. The east segment of the vein is offset about 15 feet to the north. It is 160 feet in length and also ranges from 6 to 12 inches in width. The veins are of quartz well mineralized with jamesonite, sphalerite, and galena, with a little pyrite, cosalite, and arsenopyrite. The sulphides occur disseminated through the quartz and as alternate bands of solid sulphide.

A 24-inch channel sample taken across the vein in the open-cut at elevation 5,000 feet assayed: gold, a trace; silver, 5·24 ounces a ton; lead, 11·01 per cent; zinc, 5·71 per cent; antimony, 2·68 per cent; arsenic, 2·43 per cent. An 18-inch channel sample taken across the same vein, 90 feet west at 50 feet higher elevation, assayed: gold, a trace; silver, 3·51 ounces a ton; lead, 8·00 per cent; zinc, 6·55 per cent; antimony, 2·16 per cent; arsenic, 3·20 per cent. An 8-inch channel sample taken across the east segment of the vein, 130 feet east of the open-cut, assayed: gold, 0·015 ounce a ton; silver, 0·60 ounce a ton; lead, 0·36 per cent; zinc, 0·81 per cent; antimony, none. A 10-inch channel sample taken across a strong vein at elevation 4,800 feet, 180 feet southwest of the inclined shaft, assayed: gold, a trace; silver, 15·23 ounces a ton; lead, 8·18 per cent; zinc, 16·70 per cent.

A mineralized shear zone in the granodiorite occurs on the steep east side of the cirque at elevation 4,940 feet. In a 10- by 20-foot open-cut the sheared and bleached granodiorite is impregnated with small veinlets of quartz, galena, sphalerite, and jamesonite over a width of 8 feet. A representative sample of this ore assayed: gold, nil; silver, 3·74 ounces a ton; lead, 2·82 per cent; zinc, 3·30 per cent. Fifty feet south of the open-cut, the continuation of the shear zone is covered by talus, and 50 feet north it narrows and splits into two parts, which follow north around the nose of the ridge. The eastern branch is exposed for 100 feet and the western for 160 feet. Both range from 6 to 18 inches in width and are heavily mineralized with jamesonite and sphalerite..

A considerable tonnage of high-grade silver-lead-zinc ore containing a little antimony and bismuth is indicated from the surface exposures.

Slocan Group (10)

The Slocan mineral claims, owned by J. A. Miller of South Hazelton, cover the top of Nine Mile Mountain eastward from the peak and extend down the precipitous north slope to form a unit with the Lead King claims. The showings are reached by way of the trail to the Sunrise property, there being an easy gradient from the Sunrise workings to the mountain top. The claims are 8 miles northeast of South Hazelton, but by road and trail the distance is 16 miles.

At elevation 5,500 feet, on the east side of the highest part of the mountain, a sheared zone 2 feet wide has been traced for 150 feet by a number of trenches. The country rocks are sandstones, tuffs, and argillites intruded about 600 feet to the north by the granodiorite stock that outcrops for 3 miles along the north side of the mountain. The sheared rock is sparsely mineralized, but carries at its centre a sulphide vein composed

of jamesonite, galena, and pyrite with a little quartz gangue. The vein strikes north 55 degrees west and dips 30 degrees south. It ranges from 3 to 6 inches in width. A 4-inch sample taken across the vein in the face of a 40-foot open-cut assayed: gold, a trace; silver, 5·96 ounces a ton; lead, 12·32 per cent; antimony, 4·95 per cent.

A few hundred feet farther east, at elevation 5,400 feet, a 6-inch quartz vein is followed for 100 feet by a series of rock cuts. The vein carries an abundance of jamesonite, sphalerite, and galena. It strikes north 30 degrees west and dips 37 degrees southwest. The enclosing sediments, mostly tuffaceous sandstones and argillites, strike south 40 degrees west and dip 80 degrees southeast. A 6-inch channel sample taken across a typical part of the vein midway along its outcrop assayed: gold, a trace; silver, 4·10 ounces a ton; lead, 3·73 per cent; zinc, 1·88 per cent; antimony, 1·65 per cent. About 100 feet south of the vein, and at the same elevation, there are a number of narrow, graphitic coal seams. A rough surface sample taken from the largest seam, 12 inches thick, was assayed by the Fuel Testing Laboratories at Ottawa. On a dry basis the sample contained 70·3 per cent ash, 6·9 per cent volatile matter, and 22·8 per cent fixed carbon.

At elevation 5,300 feet, roughly 600 feet farther southeast on the east side of a draw that drains south, an 18-inch quartz carbonate vein is exposed in the sediments by two open-cuts. The vein strikes north 50 degrees east and dips 70 degrees southeast. It carries about 3 per cent of arsenopyrite. A representative sample of the vein assayed: gold, nil; silver, 0·08 ounce a ton.

About 1,000 feet farther northeast on the Kootenay claim, a 33-foot adit is driven southwest on a narrow quartz vein at elevation 5,260 feet. The adit is on the north side of the mountain at the top of a bluff that drops vertically for several hundred feet. The vein in the adit ranges from 3 to 6 inches in width, strikes west, and dips 20 degrees south. The quartz gangue carries galena, jamesonite, and sphalerite. A very similar vein outcrops at the portal of the adit, strikes west, and dips 35 degrees north. It has been stripped along the surface and a little ore is piled near the adit. Both veins occur along slickensided faults in argillaceous sediments close to the granodiorite stock that lies along the north side of the mountain. Offshoots from the granodiorite mass cut the sediments 40 feet east and 30 feet west of the adit. A representative sample of the ore assayed: gold, a trace; silver, 9·85 ounces a ton; lead, 22·98 per cent; zinc, 14·57 per cent.

Silver Pick Group (11)

References: Geol. Surv., Canada, Sum. Rept. 1910, p. 98. Ann. Repts., Minister of Mines, B.C.: 1909, p. 84; 1910, p. 87; 1914, p. 205.

These claims are on the north side of Nine Mile Mountain 8 miles due northeast of South Hazelton, or 13 miles by the Nine Mile Mountain road with an additional 4 miles by trail east along the north side of the mountain from Silver Cup Basin. The claims are immediately east of the Lead King and Slocan groups. No work has been done here for many years.

The country rocks are sandstones, argillites, and bedded tuffs intruded by the east end of the granodiorite stock that extends for 3 miles along the north side of Nine Mile Mountain. In this vicinity the granodiorite stock is about 800 feet wide.

At the top of a steep ridge at elevation 4,500 feet a shaft inclined at 20 degrees is driven about 50 feet on a small quartz vein in the sediments. The vein is less than 75 feet long and has an average width of about 8 inches. It strikes north and dips 20 degrees east. The sulphide content of the vein is completely oxidized at the surface, and the resulting cavities are partly filled with a light yellow oxide of lead. A 10-inch channel sample, taken across this vein at the mouth of the shaft, assayed: gold, a trace; lead, 5·07 per cent.

About 800 feet farther east a 12-foot adit is driven on an 18-inch shear zone in the granodiorite. The shear zone is exposed for about 50 feet. It carries a litle arsenopyrite, but appears rather barren at the face of the drift. An 8-inch channel sample of the best mineralized rock near the portal assayed: gold, nil; silver, 0·51 ounce a ton. In an open-cut 125 feet farther northeast and 80 feet lower there is a 3-inch shear zone that also carries a little quartz and arsenopyrite. It is in the sediments north of the granodiorite.

At elevation 5,100 feet, there is a quartz vein in the sediments on the nose of a steep spur about 500 feet south of the granodiorite stock. The vein strikes east and dips 15 degrees south. It is about 50 feet long with an average width of 8 inches. The vein quartz carries a little jamesonite and sphalerite. An 8-inch channel sample taken across the vein midway along its strike assayed: gold, a trace; lead, 1·53 per cent; zinc, 2·84 per cent; arsenic, 3·86 per cent; antimony, 0·64 per cent.

At elevation 4,900 feet, about 1,000 feet farther east, a strong quartz vein is exposed by natural agencies at the base of a precipitous bluff. The vein ranges from 1 to 3 feet in width and is probably several hundreds of feet long. It strikes north 20 degrees east and dips 80 degrees southeast. The vein occurs along a fault plane and is characterized by numerous brecciated fragments of tuff and argillite in a finely crystalline quartz matrix. In some places the quartz is sliced by as many as four parallel fault planes, all marked by vertical striæ. The vein is very sparsely mineralized. A parallel vein of very similar appearance lies 50 feet farther west. This one is not as strong, nor is the quartz sliced by later movements, but it maintains an average width of 12 inches where exposed for several hundred feet up the steep rock bluffs. A rough, 20-inch sample taken across the main vein at elevation 4,950 feet assayed: gold, none. A representative sample taken at elevation 4,900 feet, where the vein is 2 feet wide, assayed: gold, none. A rough sample taken from the parallel vein, 50 feet to the west, assayed: gold, none.

At elevation 5,400 feet, two small veins were seen 100 feet from the mountain top at the edge of a bluff that drops precipitously towards the veins described above. The veins are in argillaceous sediments that strike north 30 degrees east and dip 80 degrees southeast. Both are quartz veins that carry an abundance of stibnite with a little sphalerite and galena.

They have an average width of about 6 inches and are somewhat over 50 feet in length. A representative sample of picked sulphide assayed: gold, a trace; silver, 4·74 ounces a ton; lead, 2·04 per cent; zinc, 0·76 per cent; arsenic, 7·32 per cent; antimony, 29·4 per cent.

O. K. Group[1] (12)

References: Ann. Repts., Minister of Mines, B.C.: 1921, pp. 91-100; 1929, p. 160.

This group is situated on the north side of Thoen Basin between elevations of 5,500 and 6,500 feet. A pack-trail 3½ miles long leads to the property from Twentyninemile Creek crossing on the Hazelton-Babine trail. Twentyninemile Creek is a southerly flowing tributary of Suskwa River approximately 29 miles east of Hazelton. Development work consists of a 40-foot crosscut adit and surface strippings.

The country rock is tuffaceous sandstone and argillite cut by alaskite and porphyritic granodiorite dykes and sills. The stratified rocks strike approximately north 40 degrees east and dip 20 to 30 degrees northwest into the face of the mountain. To the west of the property the sediments are intruded by a stock of granodiorite. A tongue projects from this stock to within 300 yards of the more important veins.

The mineral occurrences consist of small, irregular veins occupying shear zones that for the most part parallel the bedding. The veins are considerably leached, so that the filling now consists largely of iron oxide. The adit cuts through one vein 6 inches wide that is entirely leached and contains no sulphides. Another vein, varying in width from 6 inches to 2 feet, is exposed above the adit, which has not been driven far enough to cut it. This vein contains galena, light and dark brown sphalerite, and tetrahedrite, with some quartz, carbonate, and pyrite. According to Galloway,[2] a sample of the solid galena assayed: gold, 0·02 ounce a ton; silver, 190 ounces a ton; lead, 70 per cent; and a sample taken across 10 inches of leached-vein filling returned: gold, 0·02 ounce a ton; silver, 80 ounces a ton; lead, 36 per cent. Several other veins 2 to 6 inches wide have been exposed by surface strippings.

True Fissure Group[1] (13)

References: Ann. Repts., Minister of Mines, B.C.: 1921, pp. 98-99; 1927, p. 133; 1929, pp. 159-160.

This group is situated in the basin immediately west of Thoen Basin. The veins occur on the steep walls of the basin between elevations of 5,000 and 6,000 feet. The property is reached by a trail ½ mile long that branches off from the trail leading to the O. K. group. Development work consists of a 30-foot drift adit and several open-cuts.

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[1]Examined by J. E. Armstrong.
[2]Ann. Rept., Minister of Mines, B.C., 1921, pp. 99-100.

The country rock is tuffaceous sandstone, quartzite, and argillite cut by dykes of porphyritic granodiorite. The strata strike north 40 degrees east and dip 35 degrees northwest. At an elevation of approximately 6,000 feet these sediments are intruded by the granodiorite stock that occurs to the west.

The main ore occurrence is a replacement type of vein occupying a shear zone. The vein varies in width from 10 inches to 2½ feet, strikes north 75 degrees east, and dips 60 degrees to the southeast. It consists of sphalerite, galena, pyrite, tetrahedrite, and chalcopyrite in a gangue of quartz, carbonate, and altered wall-rock. In places the vein is considerably leached and consists largely of iron oxide.

At an elevation of 5,200 feet, an adit has been driven along the vein for 30 feet. Here the vein is from 10 to 12 inches wide and well mineralized with pyrite, tetrahedrite, and sphalerite. According to Lay,[1] a sample across this width assayed: gold, trace; silver, 54 ounces a ton; lead, nil; zinc, 4 per cent. One hundred and seventy-five feet farther up the slope the vein has been exposed by an open-cut. At this point it is 2½ feet wide and contains much pyrite and a little sphalerite in an 8-inch band next to the foot-wall. A sample across 10 inches assayed: gold, trace; silver, 3 ounces a ton; lead, nil; zinc, 6 per cent.[2] What appears to be the same vein is exposed at an elevation of 5,900 feet, where it is 2 feet wide. Selected ore samples assay: gold, 0·06 to 0·18 ounce a ton; silver, 76·5 to 203·4 ounces a ton; lead, 22 to 36 per cent; zinc, 20 to 30 per cent.[3]

Higgins Property[4] (14)

Reference: Ann. Rept., Minister of Mines, B.C., 1917, p. 106.

This property is situated in a cirque on the north slope of Netalzul Mountain between elevations of 4,500 and 6,000 feet. It is reached by a pack-trail, 2½ miles in length, that branches south from the Hazelton-Babine trail at a point 30 miles east of Hazelton.

A granodiorite stock intrudes the sediments on Netalzul Mountain. The contact crosses the property and the mineral showings occur within 500 yards or less of this contact both in the granodiorite and the sediments. The sediments, which are argillite, quartzite, and hornfels, strike north 40 degrees east and dip 35 degrees northwest.

The showings consist of a sulphide vein 4 inches wide and several quartz veins 2 to 7 feet wide. At elevation 4,500 feet the sulphide vein is exposed for 20 feet in an open-cut. It occurs along a small fault in the sediments less than 50 yards from the granodiorite stock. The vein strikes north 60 degrees east and dips 60 degrees southeast. It consists of sphalerite, galena, and tetrahedrite, sphalerite being the most abundant mineral.

Well within the granodiorite, at an elevation of 5,500 feet, a quartz vein 4 feet wide has been exposed by a 9-foot pit and surface stripping.

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[1], [2]Ann. Rept., Minister of Mines, B.C., 1927, p. 133.
[3] Ann. Rept., Minister of Mines, B.C., 1921, p. 99.
[4] Examined by J. E. Armstrong.

The vein strikes north 75 degrees east and dips 60 degrees southeast. It has been traced for 100 feet along its strike. The ore is bunchy and consists of sphalerite, galena, tetrahedrite, pyrite, and chalcopyrite. The sulphides consitute less than 5 per cent of the vein material. A sample containing about 25 per cent sulphides assayed: gold, 0·10 ounce a ton; silver, 56·14 ounces a ton. A sample containing no sulphides assayed 0·01 ounce a ton in gold.

Two hundred yards down the slope at an elevation of 5,400 feet another quartz vein, varying in width from 2 to 7 feet, is exposed. It occurs in the granodiorite as a filling along joint planes that strike north 20 degrees east and dip 60 degrees southeast. At various points along its strike it is offset from a few inches up to 5 feet along a second set of joint planes, which strike north 60 degrees west and dip 70 degrees northeast. This vein could be traced for at least 2,000 feet. It is very sparsely mineralized with galena, sphalerite, tetrahedrite, and pyrite.

Elsewhere on the property quartz stringers, ½ to 1 inch wide and mineralized with pyrite, occur along the joint planes in the granodiorite.

American Boy Group (15)

References: Ann. Repts., Minister of Mines, B.C.: 1910, p. 87; 1911, p. 79; 1912, p. 112; 1913, p. 106; 1914, pp. 197-199; 1915, p. 76; 1916 p. 89; 1917, p. 104; 1918, p. 117; 1923, p. 107; 1927, p. 131. Geol. Surv., Canada, Sum. Rept. 1912, p. 104; Mem. 110, 1919, p. 33.

The American Boy mining property is on the southwest slope of Nine Mile Mountain, 6 miles northeast of Hazelton. The Nine Mile Mountain motor road passes along the base of the mountain at elevation 1,575 feet, one-half mile west of the mine workings, which lie between elevations of 2,500 and 2,900 feet. The camp and workings are reached from the road by a switchback horse trail. The property comprises eight Crown granted claims, which were first staked by D. A. Harris in 1910. Between 1910 and 1915, Harris Mines, Limited, carried on intermittent development work, and between 1912 and 1914 it is stated that 100 tons of high-grade silver-lead ore were shipped, worth about $7,000. In 1915, a shipment of 15 tons sent to the Trail smelter assayed: gold, 0·04 ounce a ton; silver, 98 ounces a ton; lead, 30 per cent; zinc, 14 per cent. In 1918, 240 tons of lower grade ore was hauled from the dumps to the Silver Standard mill for treatment. Harris Mines, Limited, did a little further work late in 1927 when a crosscut was extended from the bottom of the main shaft to pick up the vein. Operations were suspended in December 1927 when a flow of water was encountered. Viking Mining Company of Vancouver did some work during the spring months of 1937. The property is owned by Mrs. B. Sargent of New Hazelton.

The claims are underlain by well-bedded, sedimentary rocks striking north and dipping about 15 degrees west (*See* Figure 4). A grey, clastic, bedded rock, which has the appearance of an impure sandstone, is most common. Thin section examination shows this rock to be composed of volcanic ash, crystallites, devitrified glass grains, and magnetite shreds, with a strong development of calcite, so that the rock is calcareous tuff.

The tuffs are interbedded with fine-grained argillites. Several poorly preserved fossil shells were seen in tuffaceous sandstones along the trail to the camp at elevation 2,450 feet, and some shells are reported to have been found in the mine workings.

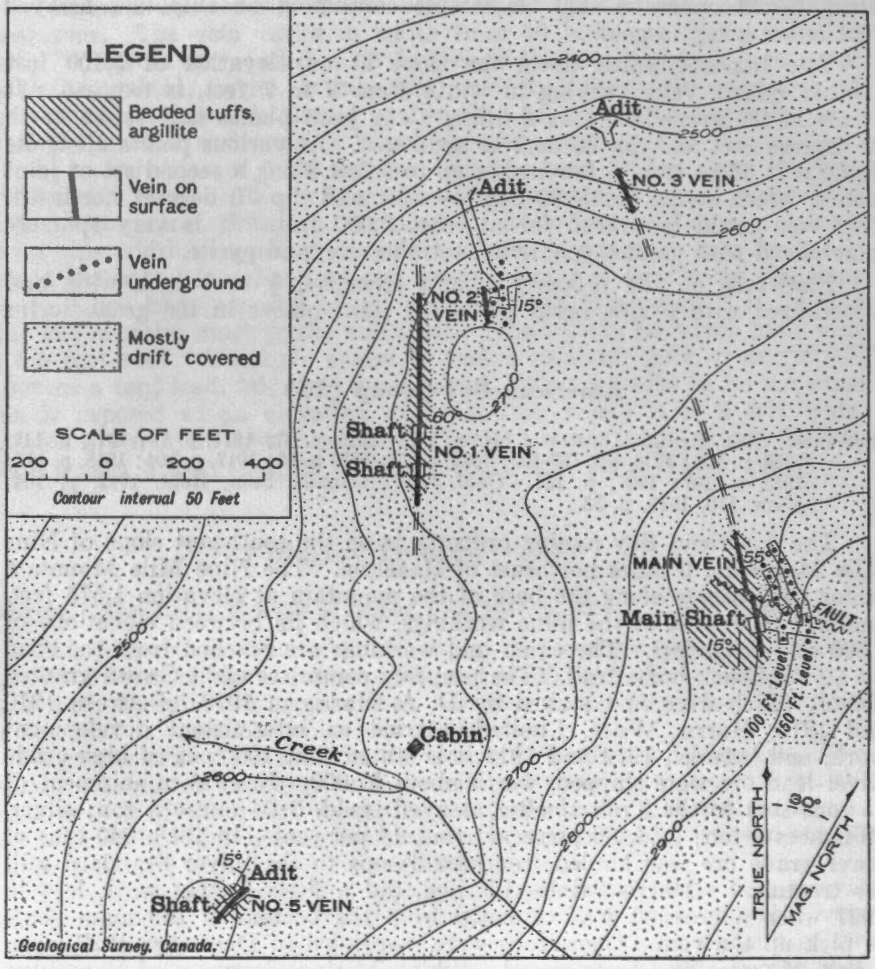

Figure 4. Plan of part of American Boy group.

Five quartz veins occur along fault fissures traversing the tuffs and argillites. Four of these veins strike roughly north and dip from 40 to 70 degrees east. The fifth and most southerly vein strikes northeast and dips 80 degrees southeast. The veins range from 4 inches to 4 feet in width, and consist of quartz with occasional carbonate stringers, and with both banded seams and irregular patches and bunches of sulphides scattered

irregularly through them. The ore minerals in order of abundance are, galena, zinc blende, arsenopyrite, tetrahedrite, and pyrite. Both galena and tetrahedrite carry a high silver content and the arsenopyrite carries considerable gold.

No. 1 vein is the most westerly, No. 2 vein lies 180 feet east of No. 1 vein, and No. 3 vein lies 400 feet east of No. 2 vein. The main or No. 4 vein is 800 feet east of the No. 1 vein and 900 feet south of the No. 3 vein. As Nos. 3 and 4 veins are on the same strike they may be the same vein. If so, its total length would exceed 1,300 feet. No. 5 vein is 1,200 feet southwest of No. 1 vein.

No. 1 vein has been traced along the surface by stripping and by open-cuts for over 300 feet. Two inclined shafts 100 feet apart were sunk on the vein about 1912, but are now water-filled. Between these shafts, the vein ranges from 3 to 4 feet in width and carries from 3 to 5 per cent of sulphides, chiefly galena, sphalerite, and tetrahedrite, with a little chalcopyrite. Towards its north end the vein narrows to 2 feet and is very sparsely mineralized. According to the 1914 report of the Minister of Mines, British Columbia, the south shaft is 100 feet deep on a 60-degree incline, with drifts at 27 and 50 feet. The following quotations are from the 1914 report.

"The drift on the 27-foot level has been run in to the north 12 feet; a sample taken across 20 inches at the face of the drift assayed: gold, 0·04 ounce; silver, 47·4 ounces; lead, 11·0 per cent."

"On the 50-foot level the drift extends 6 feet to the south: a sample was taken at the face here across a width of 22 inches which assayed: gold, 0·02 ounce; silver, 15 ounces."

A representative sample of broken ore collected by the writer from a small ore dump at the south shaft assayed: gold, 0·015 ounce a ton; silver, 8·82 ounces a ton; lead, 2·39 per cent; zinc, 0·26 per cent; copper, 0·18 per cent; arsenic, nil. A sample of somewhat similar broken ore, collected from the dump at the north shaft, assayed: gold, 0·02 ounce a ton; silver, 81·93 ounces a ton; lead, 6·90 per cent; zinc, 5·49 per cent; copper, 0·68 per cent; arsenic, 0·34 per cent.

No. 2 vein is followed for about 100 feet along its strike by rock cuts and stripping. Where exposed, the vein ranges from 16 inches to 4 feet in width and carries about 1 per cent of sulphides, but some high-grade ore was removed from the main open-cut years ago. At elevation 2,550 feet, 125 feet vertically below the vein outcrop, an adit was run south 250 feet to intersect the vein and the vein was drifted along for 45 feet. At the end of the drift a crosscut runs 20 feet west to a branch vein, which is drifted along for 26 feet. Both veins range from 4 to 12 inches in width where exposed in the workings, and both are very sparsely mineralized. An 8-inch channel sample taken across the branch vein 15 feet from the face assayed: gold, a trace; silver, 0·23 ounce a ton. A crosscut extends an additional 80 feet east from the drift on the main vein, but cuts no other veins.

No. 3 vein is exposed in trenches about 400 feet east of the portal of the adit to the No. 2 vein. It has been followed for about 200 feet up the mountainside, but the vein is mostly concealed now due to caving in of the trenches. At elevation 2,515 feet an adit was driven 32 feet towards

the lower end of the vein, but not far enough to connect with it. A sample of massive arsenopyrite veined by galena stringers was taken from an ore pile at a pit 150 feet up the slope from the short adit. It assayed: gold, 1·435 ounces a ton; silver, 10·81 ounces a ton; lead, 13·46 per cent; arsenic, 35·70 per cent.

The main vein (No. 4) is followed along its strike by surface cuts and by the underground workings for 300 feet. At elevation 2,850 feet the vein is developed by an inclined shaft with levels at 100 and 160 feet down the slope. Below the second level the mine is water filled, but there is said to be a short drift from the bottom of the shaft. On the 100-foot level a drift follows the vein 45 feet south from the shaft and 132 feet north from the shaft. In the south drift the vein ranges from 4 to 10 inches in width. It consists of banded quartz with carbonate seams and contains about 2 per cent of arsenopyrite, galena, sphalerite, and tetrahedrite. A 6-inch channel sample taken across the vein on the face of the south drift assayed: gold, 0·01 ounce a ton; silver, 17·28 ounces a ton; lead, 2·35 per cent; zinc, nil; arsenic, 0·08 per cent. At the shaft the vein has a width of 10 inches and 30 feet north of the shaft at a cross fault it has widened to 3 feet. The fault strikes north 70 degrees west and dips steeply. The northerly continuation of the vein is moved 25 feet to the west along the fault. A raise is driven up for 50 feet along the vein at a point 60 feet north of the shaft and considerable ore was stoped out between the raise and the cross fault. On the north side of the raise the vein ranges from 8 to 20 inches in width, and in places carries up to 50 per cent of sulphide. An altered aplite dyke lies on the foot-wall side of the stope, but there is probably no direct relation between the ore shoot and the dyke as larger ore shoots occur elsewhere in the mine where both wall-rocks are tuffaceous sediments. A similar altered aplite dyke about 15 feet wide lies on the west side of the vein at the collar of the shaft. This dyke was intruded prior to the formation of the fault fissure along which the vein occurs, as it is cut off sharply at the vein. Numerous horizontal fault striæ along the vein indicate that movement was horizontal. About 15 feet north of the raise, on the 100-foot level, there is a minor fault that strikes north 30 degrees west and dips 15 degrees southwest, and there the northerly continuation of the vein is offset a few feet to the east. Twenty feet north of the raise, a stope from the 160-foot level breaks through the floor of the drift. A 9-inch channel sample taken across the vein from the roof of the stope, 5 feet below the floor of the 100-foot level, assayed: gold, 0·023 ounce a ton; silver, 12·02 ounces a ton; lead, 2·35 per cent; zinc, 4·98 per cent; arsenic, 3·65 per cent. A 7-inch channel sample taken across the vein at the face of the north drift, 133 feet north of the shaft, assayed: gold, 0·09 ounce a ton; silver, 19·57 ounces a ton; lead, 11·68 per cent; zinc, 0·66 per cent; arsenic, 9·90 per cent.

On the 160-foot level, the vein is developed by a drift that runs 242 feet north from the shaft. A 24-inch channel sample taken across the vein 10 feet north of the shaft, where the quartz carries about 2 per cent of sulphide, assayed: gold, a trace; silver, 0·10 ounce a ton; lead, 0·70 per cent; zinc, 1·2 per cent. Forty feet north of the shaft the vein is offset 25 feet to the west along the cross fault mentioned on the level above. There is a raise and small stope on the vein 100 feet north of the shaft,

where the vein widens to 2 feet. A 20-inch channel sample taken across the vein 6 feet south of this raise assayed: gold, 0·02 ounce a ton; silver, 19·64 ounces a ton; lead, 13·41 per cent; zinc, 1·63 per cent. There is another raise 145 feet north of the shaft and there a stope about 30 feet wide extends through almost to the 100-foot level. Forty feet north of this raise the vein narrows to 12 inches and splits into two parts. The east branch pinches to 3 inches, and in a few feet passes into the east wall of the drift. The main branch ranges from 4 to 6 inches in width for 45 feet to the face of the drift and contains from 1 to 2 per cent of sulphides. A 6-inch channel sample taken across the vein at the face of the drift assayed: gold, 0·06 ounce a ton; silver, 0·21 ounce a ton. A 12-inch channel sample taken across the vein 8 feet south of the junction of the two arms of the vein assayed: gold, 0·04 ounce a ton; silver, 0·085 ounce a ton; lead, nil; zinc, nil; arsenic, 2·86 per cent.

The No. 5 or "Mullan" vein is developed by a vertical shaft 25 feet deep and a rock cut and adit 65 feet in length, which connect with the shaft. The vein has an average width of 14 inches and contains irregular ore shoots. In the shaft the vein quartz appears relatively barren. A 14-inch channel sample taken across the vein at the bottom of the shaft assayed: gold, 0·01 ounce a ton; silver, 5·38 ounces a ton. Samples of ore piled near the portal of the adit carry from 5 to 10 per cent of sulphide. The quartz gangue is cut by rusty carbonate stringers and carries galena, sphalerite, tetrahedrite, and a little chalcopyrite. A representative sample of the ore dump assayed: gold, 0·01 ounce a ton; silver, 27·89 ounces a ton; lead, 2·91 per cent; zinc, 5·64 per cent; copper, 0·62 per cent.

Attention is drawn to the high gold content of the arsenopyrite ore of the No. 3 vein. Ore of similar appearance occurs on the surface in No. 4 vein, 150 feet north of the main shaft. Should surface trenching prove Nos. 3 and 4 veins to be one vein, the ore could be efficiently handled by an adit run as a drift.

Surprise Group (17)

References: Ann. Repts., Minister of Mines, B.C.: 1912, p. 112; 1913, p. 106; 1915, p. 76; 1917, p. 107.

The Surprise claims are immediately north of and adjoin the Silver Standard property. In 1912 and 1913 a crosscut adit was driven and one vein was explored by a drift and raise. There is no record of work done since 1917 when the original owner, W. Thompson, sold the claims to B. R. Jones.

The Surprise adit is at elevation 1,485 feet, the portal being 1,250 feet northeast of the portal of the main crosscut adit on the Silver Standard property. The adit is driven south 37 degrees east for 740 feet, and 200 feet from the portal a drift runs northeast for 96 feet and southwest for 20 feet from the crosscut. From the northeast drift two raises were driven through to the surface. The drift follows along a 6-inch vein of quartz and calcite, which is sparsely mineralized with pyrite. At the face of the northeast drift the vein has decreased to a 1-inch stringer, and 6 feet from the face of the southwest drift the vein ends against a cross fracture.

The rocks exposed in the adit are like those on the Silver Standard property, consisting of grey, coarse- to fine-grained, massive arkose beds with interbedded tuffs and finely laminated argillites. These sediments strike dominantly northeast and dip from 10 to 25 degrees southeast.

A 6-inch channel sample taken across the vein in the roof of the drift 25 feet northeast of the crosscut assayed: gold, 0·01 ounce a ton; silver, 0·028 ounce a ton; lead, a trace; zinc, 0·10 per cent. Another 6-inch channel sample, taken across the vein in the roof of the drift 40 feet northeast of the crosscut, assayed: gold, 0·04 ounce a ton; silver 0·35 ounce a ton; lead, a trace; zinc, 0·10 per cent.

At 430 feet from the portal, a 2-inch vein of quartz and calcite dipping 45 degrees east is cut. The adit is a few feet short of striking a possible continuation of the main vein from the Silver Standard mine.

Silver Standard Mine (18)

References: Geo. Surv., Canada, Sum. Rept. 1912, p. 105; Mem. 110, 1919, pp. 27-32. Ann. Repts., Minister of Mines, B.C.: 1911, pp. 81 and 99; 1912, pp. 112 and 116; 1913, p. 105; 1914, p. 194; 1915, p. 76; 1916, pp. 89 and 119; 1917, p. 106; 1918, p. 115; 1919, p. 101; 1920, p. 84; 1921, p. 97; 1922, p. 98; 1923, p. 105; 1924, p. 93.

The Silver Standard mine is on Glen Mountain about 6 miles by good motor road northwest of New Hazelton railway station. The principal veins and mine workings are on the west side of the mountain between elevations of 1,200 and 2,000 feet. The property was first staked in 1910 by Messrs. McBean and Long, from whom it was purchased and developed by Stewart, Welsh, McLeod, and associates of Vancouver. The first shipments of gold-silver-lead-zinc ore were made in 1913, and by June 1917, 2,229 tons of silver-lead ore had been shipped, carrying 746,259 pounds of lead, 516·8 ounces of gold, and 304,411 ounces of silver, with an average of 20·3 per cent of zinc. In 1916 and to the end of May 1917 393·9 tons of zinc ore were shipped, which averaged 43·16 per cent of zinc, 0·24 ounce of gold, and 60·02 ounces of silver, making a total of 328,050·5 ounces of silver. In 1918 a 50-ton mill of the water concentrator type was built. About 4,000 tons of ore was treated in the mill in both 1919 and 1920, but the mine was closed throughout 1921. The mine reopened for 3 months early in 1922, when an additional 900 tons or ore was mined and milled. From 900 tons, 165 tons of concentrates were produced with returns of 45 ounces of gold, 20,191 ounces of silver, 21,071 pounds of zinc, and 30,979 pounds of lead. The 1923 Annual Report of the Minister of Mines, British Columbia, gives the production record of the Silver Standard mine as: 14,500 tons of ore mined and milled to produce 1,100 ounces gold, 626,000 ounces silver, 1,225,000 pounds lead, 1,400,000 pounds zinc, with a gross value in the neighbourhood of $500,000.

The property was under active development by Canadian Cadillac Gold Mines, Limited, of Montreal, during 1938, but operations were suspended early in 1939 owing to lack of funds.

Glen Mountain is composed of a thick series of gently folded sedimentary rocks ranging from coarse, grey, impure sandstones and greywacke to finely laminated, grey to green argillites. The sandstones contain

numerous rounded fragments of lava and by admixture of material of direct volcanic origin graduate into beds of tuff. Some of the sandstone is highly feldspathic and grades into arkose. On the west slope of the mountain, on the Silver Standard property, the sediments form a low anticline with the limbs of the fold dipping east and west and the axial plane striking north. At the lower mine adit the beds dip up to 35 degrees west, and east of the main shaft they dip from 5 to 15 degrees east. On the east side of the mountain the strata turn up again sharply. This broad structure is interrupted by numerous minor folds on the limbs of the anticline. The west limb of the anticline is intruded between elevations of 1,300 and 1,700 feet by two small stocks of porphyritic granodiorite. The largest of these has an average diameter of about 500 feet.

There are ten veins on the property, all striking northeast and dipping from 50 to 70 degrees southeast (*See* Figure 5). The veins occur along strong fault fissures in the gently folded sedimentary rocks, and in one case (No. 3 vein) extend into the intrusive granodiorite. They lie from 100 to 400 feet apart and range from 100 to 1,000 feet in length and from 6 inches to 8 feet in width. They occur within a breadth of 2,000 feet from west to east across the mountain, and for convenience are numbered consecutively from west to east.

The ore consists of banded and massive galena, sphalerite, and tetrahedrite, with associated pyrite and arsenopyrite in a quartz gangue. Minor amounts of chalcopyrite, tennantite, jamesonite, and calcite also occur. The ore carries a high silver content with an appreciable gold content in some of the veins. The gold is associated with arsenopyrite, whereas the silver values occur wherever the galena and sphalerite are found. Production figures on 14,500 tons of ore mined and milled indicate an average recovery of 0·075 ounce of gold a ton and 43·17 ounces of silver a ton. The veins are very variable in mineral content throughout their length and depth and pass unexpectedly from barren quartz into ore shoots of importance.

The main workings consist of two long crosscut adits with drifts, and a 400-foot inclined shaft on the main vein with levels at 150 feet, 250 feet, and 400 feet. At the bottom of a winze that extends 86 feet below the 400-foot level there is 400 feet of drifting on the main vein. The main shaft is now in disrepair and was closed off below the 250-foot level when visited in 1937. The upper crosscut adit connects with the shaft on the 250-foot level.

The lower adit, at elevation 1,300 feet, is 950 feet long with a 75-foot drift on the No. 1 vein at 350 feet from the portal and a 15-foot drift on the No. 2 vein at 453 feet from the portal. At 762 feet within the adit, a third vein 6 inches wide is intersected, on which no drifting has been done.

The upper (No. 2) crosscut adit, at elevation 1,507 feet (elevation by aneroid barometer), reaches the No. 4 vein at 400 feet from the portal, the No. 5 vein at 495 feet, the No. 6 vein at 688 feet, and the No. 7 or main vein at 880 feet. There is 383 feet of drifting on No. 4 vein, 87 feet of drifting on No. 5 vein, and 48 feet of drifting on No. 6 vein. The drift on the main vein runs 248 feet south from the main crosscut and 517 feet north, and connects with the inclined shaft 320 feet north of the long

crosscut. Near the shaft there is 118 feet of drifting along the hanging-wall vein. From the shaft a crosscut runs east for another 435 feet and cuts the No. 8 vein 400 feet east of the shaft or 1,280 feet east of the portal of the main adit.

Most of the ore mined during the 1911-1922 period of activity came from the No. 4 vein and from the No. 7 main vein and hanging-wall vein. Some ore was taken from open-cuts on the No. 1 and No. 8 veins. There is a stoped zone 230 feet in length above the drift level on the No. 4 vein. Above the drift on the main vein, 250-foot level, a stoped zone 150 feet in length in the vicinity of the shaft, and 90 feet of stoping on the adjacent hanging-wall vein were seen.

The old Silver Standard mill on Twomile Creek about 2 miles by road from the mine is now in a dilapidated condition. During its active period, the ore was hauled from the mine to the mill by trucks and lead and zinc concentrates were made for shipment. As a rough test of the mill's efficiency three samples were collected for assay from a quartz tailings dump measuring about 50 by 100 by 6 feet, which lies on the southeast side of the building. The tailings consist of quartz fragments with from 2 to 3 per cent of sulphides, mostly from $\frac{1}{8}$ to $\frac{1}{4}$ inch in diameter, with 30 per cent of finer ground quartz. A 30-inch channel sample taken from a hole dug at the centre of the dump assayed: gold, 0·025 ounce a ton; silver, 7·05 ounces a ton; lead, 0·56 per cent; zinc, 1·27 per cent. From a hole dug 35 feet from the southeast side of the dump, a similar 30-inch channel sample was collected, which assayed: gold, 0·03 ounce a ton; silver 7·79 per cent; lead, 0·66 per cent; zinc, 1·78 per cent. A grab sample taken 1 foot below the top of the dump 40 feet from the mill and assayed for gold and silver only, gave: gold, 0·035 ounce a ton; silver, 7·64 ounces a ton. On the north side of the mill another 30-inch channel sample taken from a hole at the centre of a second somewhat smaller tailings dump assayed: gold, 0·025 ounce a ton; silver, 7·19 ounces a ton; lead, 0·56 per cent; zinc, 3·81 per cent.

No. 1 Vein. The No. 1 or most westerly vein, at elevation 1,400 feet, is traced along the surface for 500 feet by a number of open-cuts (*See* Plate II). The vein strikes north 42 degrees east and dips 65 degrees southeast. It ranges from 8 inches to 5 feet in width. Midway along the vein, ore has been removed to a depth of 10 feet by an open-cut 35 feet long. In the north end of the cut the vein is 3 feet wide where a raise comes through from the lower adit. In the south end of the cut, the vein narrows to 8 inches. An 8-inch channel sample taken here across the vein assayed: gold, 0·545 ounce a ton; silver, 6·62 ounces a ton; lead, 0·78 per cent; zinc, 14·48 per cent; arsenic, 3·61 per cent; antimony, nil. In a second cut 20 feet north of the head of the raise, the vein widens to 5 feet and is well mineralized. A 5-foot channel sample taken across the vein in this cut asayed: gold, 0·37 ounce a ton; silver, 16·32 ounces a ton; lead, 0·87 per cent; zinc, 18·87 per cent; arsenic, 7·33 per cent; antimony, nil; bismuth, nil.

This vein is intersected in the lower adit at 350 feet from the portal and is explored by a drift that runs 41 feet south and 35 feet north from the crosscut adit. A 90-foot raise goes through to the surface from the

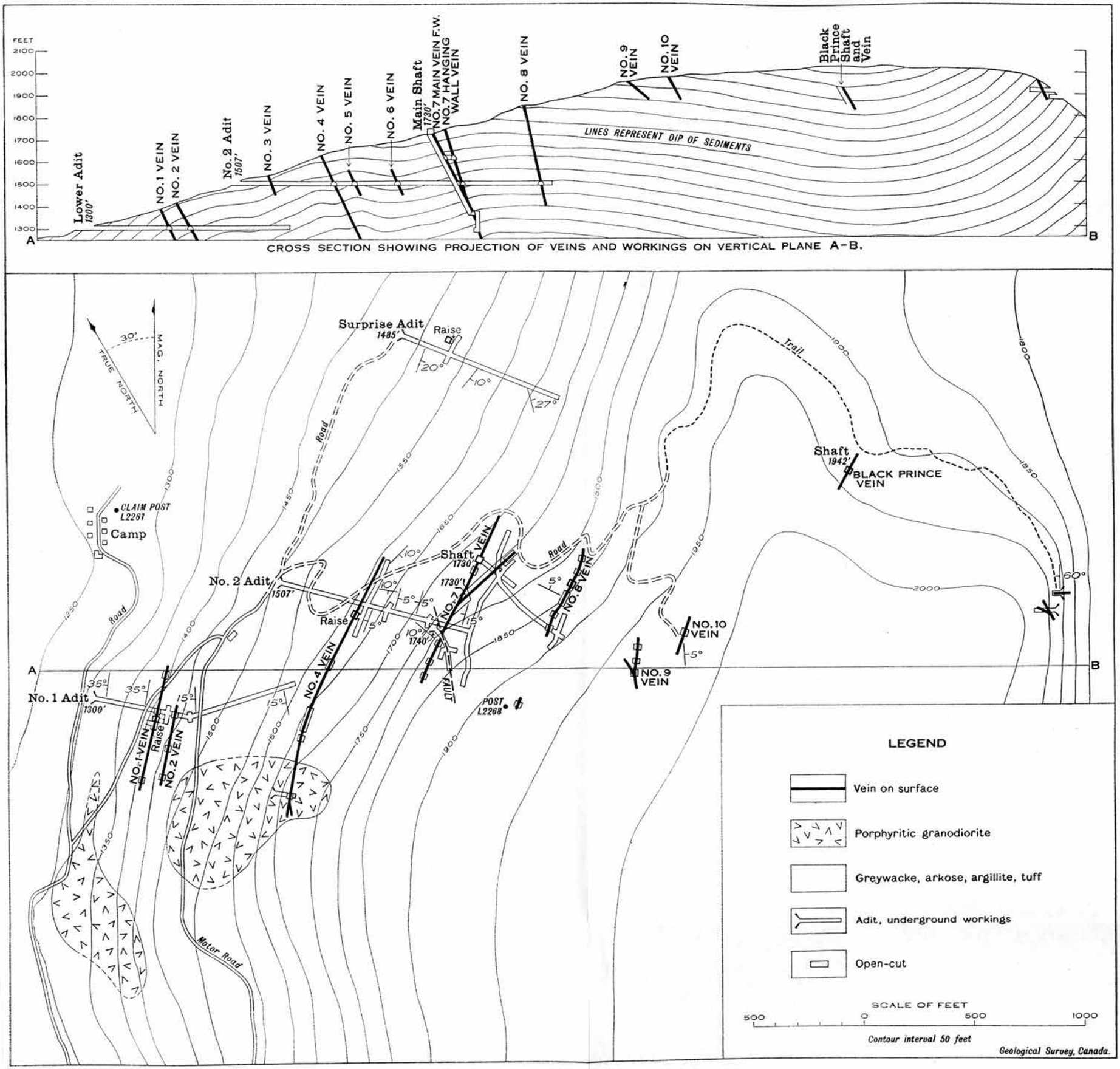

Figure 5. Plan and section of part of the Silver Standard property.

No. 1 Adit
No. 2 Adit
Surprise Adit
BLACK PRINCE
Camp
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end of the south drift. At the face of the south drift the vein consists of 12 inches of milky quartz sparsely mineralized. At the face of the north drift, the vein is 3 feet wide and is rich in sphalerite over a width of 12 inches on the hanging-wall side of the vein, with about 5 per cent sphalerite throughout the remaining 2 feet. A 3-foot channel sample taken across this face assayed: gold, 0·13 ounce a ton; silver, 44·36 ounces a ton; lead, 0·28 per cent; zinc, 10·82 per cent.

No. 2 Vein. This vein lies 95 feet east of the No. 1 vein and outcrops 35 feet higher on the mountain slope. Its strike and dip are almost identical with that of the No. 1 vein, but it has been traced for only 250 feet along its strike. The vein is narrow but persistent, with widths ranging from 6 to 12 inches. The quartz gangue carries an abundance of arsenopyrite and pyrite with some shoots rich in galena and sphalerite. A 6-inch channel sample taken across the vein in a cut midway along its strike assayed: gold, 1·215 ounces a ton; silver, 60·49 ounces a ton; lead, 5·42 per cent; zinc, 3·61 per cent; arsenic, 3·80 per cent; antimony, 0·28 per cent.

In the lower adit where this vein is intersected 100 feet east of the No. 1 vein, it is 8 inches wide and the quartz gangue contains up to 30 per cent of galena and sphalerite. It has been drifted along for only 20 feet. This vein has 150 feet of backs between this level and the surface.

No. 3 Vein. This was the first vein encountered in the No. 2 crosscut adit at 140 feet from the portal. Water backed up by the caving in of the portal of the adit prevented its examination in the 1937 season. O'Neill (1919) describes the vein as consisting of about 6 inches of mixed ore. In the lower adit a 6-inch vein containing about 50 per cent of galena and sphalerite occurs at 180 feet from the face of the adit. The surface outcrops of both veins are drift covered.

No. 4 Vein. The No. 4 vein is the strongest vein on the property, having been traced by surface trenching and by the underground workings for a distance of 1,200 feet along the strike. The vein ranges in strike from north 40 degrees east at its southern extremity to north 58 degrees east at its north end, and the dip ranges from 65 to 80 degrees southeast. The surface trace of the vein climbs slowly from an elevation of 1,615 feet at an old shaft near its north end to 1,715 feet at its south end. The southern extremity of the vein is enclosed for 200 feet in granodiorite. An average vein width of 2 to 3 feet of quartz is maintained on passing from the sedimentary rock into the intrusive, but the vein carries much less sulphide where the granodiorite forms the wall-rock. Near the centre of the stock the vein widens to 7 feet and contains about 1 per cent of galena and 1 per cent of pyrite. A chip sample taken across the 7-foot vein in a rock cut assayed: gold, 0·015 ounce a ton; silver, 0·17 ounce a ton; lead, a trace. The vein splits and pinches about 50 feet farther south. An old adit driven in the granodiorite 50 feet below the 7-foot vein outcrop was too filled with mud and water to permit entry.

The vein is cut by the No. 2 crosscut adit at 400 feet from the portal, and is drifted along for 230 feet north and 154 feet south from the crosscut. Much of the vein has been partly stoped out immediately above this

drift for 100 feet north and 135 feet south of the crosscut. The ore removed ranged from 12 inches to 3 feet in width. At the face of the south drift the vein ranges from 12 to 15 inches in width and carries from 15 to 20 per cent of sulphides, chiefly arsenopyrite, galena, and sphalerite. A 12-inch channel sample taken here across the face assayed: gold, 0·40 ounce a ton; silver, 22·10 ounces a ton; lead, 5·25 per cent; zinc, 39·52 per cent.

At 150 feet north, in the north drift, the vein pinches from 3 feet to 1 foot, and this width is roughly maintained north to the face of the drift. At the face the vein ranges from 6 to 12 inches in width and consists of white, milky quartz sliced parallel the vein by small horizontal fault movements, with finely banded seams of pyrite and galena along these planes. A 7-inch channel sample taken across the vein, at the face, assayed: gold, 0·05 ounce a ton; silver, 14·20 ounces a ton; lead, 0·74 per cent; zinc, 1·48 per cent.

No. 5 Vein. The No. 5 vein lies 95 feet east of the No. 4 vein. It is developed by a 32-foot drift north and a 55-foot drift south from the long crosscut. The vein is 8 inches wide at the crosscut, but at the face of the north drift it has pinched to 2 inches wide. In the south drift there is a 30-foot ore lens 3 feet in width on which a little stoping has been done, but at the face the vein is pinched to a width of 4 inches.

No. 6 Vein. The vein is 193 feet east of the No. 5 vein and is cut in the No. 2 crosscut adit 685 feet from the portal. There is 48 feet of drifting, 16 feet north and 32 feet south from the crosscut. The vein is only 4 inches wide at the face of the north drift but it widens gradually, being 12 inches wide at the crosscut and 3 feet wide at the face of the south drift. It contains from 5 to 15 per cent of sulphide throughout, most of which is pyrite and arsenopyrite. A 3-foot channel sample taken across the face of the south drift assayed: gold, 0·07 ounce a ton; silver, 0·57 ounce a ton; lead, none; zinc, none.

No. 7 or Main Vein. The main vein is followed along the surface and in the mine workings for a distance of 800 feet along its strike. From the main shaft, at elevation 1,730 feet, the vein is followed south up the slope by a series of open-cuts for 600 feet, to an elevation of 1,830 feet. Scattered quartz float seen several hundred feet farther south suggests that it continues in that direction. The vein strikes north 55 degrees east and dips 60 degrees southeast. At the shaft the vein ranges from 2 to 4 feet wide, and the quartz gangue is well mineralized with galena and sphalerite. A large sample of almost solid galena with a little sphalerite and freibergite, collected on the south side of the collar of the shaft, assayed: gold, 0·04 ounce a ton; silver, 146·95 ounces a ton; lead, 81·60 per cent; zinc, 1·12 per cent; antimony, 0·57 per cent.

A short crosscut adit driven east at a point 150 feet south of the collar of the shaft cuts the main vein at 26 feet from the portal and the hanging-wall vein at 56 feet from the portal. The latter vein branches easterly at a small angle from the main vein at a distance of 230 feet south of the shaft at the surface. In a 30-foot drift the main vein is 8 inches wide and carries from 5 to 15 per cent of sulphides. The hanging-wall vein is drifted on for 60 feet in this adit. It maintains an 8-inch ore width

for 50 feet from its junction with the main vein, and then it pinches. A stope 20 feet long is carried through to the surface on what was evidently a very rich part of the vein.

A second short adit is driven east to intersect the main vein from a point 375 feet south of the collar of the main shaft. The adit intersects the vein 57 feet from the portal, but here the vein is offset for 20 feet by a fault. A drift that follows the fault line for 150 feet shows it to be barren. The fault strikes north 20 degrees east and dips 75 degrees southeast. The main vein is explored south of the fault line by a 50-foot drift reached by a short crosscut from the drift on the fault. Here, the vein ranges from 21 to 30 inches in width and the quartz gangue is banded by fine seams of sulphide, most of which is pyrite and arsenopyrite with some galena. An 18-inch channel sample taken across the vein from the roof of the drift, 15 feet from the face, assayed: gold, 0·025 ounce a ton; silver, 14·96 ounces a ton; lead, 5·30 per cent; zinc, nil. A 13-inch channel sample taken across the vein from the roof of the drift, 25 feet from the face, assayed: gold, 0·085 ounce a ton; silver, 0·21 ounce a ton; lead, nil; zinc, nil.

The main vein is reached by the No. 2 crosscut adit 192 feet east of the No. 6 vein or 880 feet from the portal of the adit. On this level the vein is drifted on for 765 feet. The drift extends 248 feet south and 517 feet north from its intersection with the main crosscut. This drift reaches the main shaft 320 feet north of the end of the main crosscut. Near the shaft there is a 118-foot drift along the hanging-wall vein. The main vein is continuously exposed along the 765-foot drift, and ranges from 6 inches to 5 feet in width. For most of this distance the vein is of white, milky quartz sparsely mineralized with iron, lead, and zinc sulphides. An ore shoot that extended 50 feet south and 100 feet north of the shaft was developed by two raises to the 150-foot level and considerable stoping was done from both levels. The hanging-wall vein, which joins the foot-wall vein 50 feet south of the shaft on this level, furnished an ore shoot 80 feet long, varying from 2½ to 4 feet in width. This vein pinches to a width of 4 inches of quartz 100 feet northeast along its strike from the main vein.

Water and general disrepair of the shaft prevented an examination of the 150-foot level, the 400-foot level, or the level at the bottom of the winze.

O'Neill (1918) states that the main vein ore shoot is 200 feet long on the 150-foot level and that it varied from 6 inches to 8 feet in width, averaging 4 feet to the surface. At the 400-foot level the ore shoot was 100 feet long, varying from 18 inches to 3 feet in width. In the drift at the bottom of the winze, 86 feet below the 400-foot level, there is 6 inches of good grade ore for the total distance of 400 feet drifted.

In describing the hanging-wall vein O'Neill states: "On the 150-foot level the shoot is known to be 95 feet in length. . . On the 400-foot level this shoot has been opened up in a drift over 100 feet in length and the ore is 6 inches in width, occurring along a well-defined hanging-wall. . . . A raise was put up from the 400-foot level in this shoot and it widened in a short distance to 3 feet, with a larger content of galena."

No. 8 Vein. The No. 8 vein is 400 feet east of the main vein, and has been traced along the surface for 380 feet between elevations of 1,830 and 1,880 feet. The vein strikes north 55 degrees east and dips 70 degrees

southeast. Two shallow shafts are sunk on it about 100 feet apart and ore is removed between the shafts in a trench 75 feet long and 10 feet deep. The vein ranges from 6 to 12 inches in width in the surface cuts and carries about 5 per cent of sulphides. In a cut at the south end of the vein, 130 feet south of the deeper shaft, an 8-inch channel sample taken across the vein assayed: gold, 0·025 ounce a ton; silver, 3·16 ounces a ton; lead, nil; zinc, nil.

Fifty feet above the last-mentioned cut, and 360 feet farther south, there is an exposure of quartz 6 feet in diameter, the strike and dip of which were indeterminable due to drift cover. A representative sample of this outcrop assayed: gold, 0·06 ounce a ton; silver, 0·16 ounce a ton.

On the 250-foot level (No. 2 adit) the No. 8 vein is cut by a crosscut 400 feet east of the main shaft. A drift follows the vein 96 feet north and 75 feet south from the crosscut intersection. The vein gangue consists of white, milky quartz containing up to 10 per cent of fine pyrite and arsenopyrite, and ranges from 4 feet in width at the crosscut intersection to 8 inches in width at both faces of the drift. An 8-inch channel sample taken across the vein in the south face of the drift assayed: gold, 0·025 ounce a ton; silver, 0·11 ounce a ton; lead, none. A representative sample of the vein quartz from the 4-foot lens at the crosscut, carrying about 20 per cent of fine sulphides, assayed: gold, 0·105 ounce a ton; silver, 0·16 ounce a ton.

A parallel vein ranging from 6 to 12 inches wide was seen in the crosscut 50 feet west of the No. 8 vein, but no work has been done on it.

Nos. 9 and 10 Veins. These veins lie 400 and 600 feet, respectively, east of the No. 8 vein and are at an elevation of about 1,970 feet. They have an average width of 1 foot and each has been traced for about 100 feet. In both veins the quartz gangue carries up to 5 per cent of pyrite, arsenopyrite, galena, and sphalerite. A representative sample from the north cut on No. 9 vein assayed: gold, 0·03 ounce a ton; silver, 1·73 ounces a ton; lead, 0·31 per cent; zinc, nil. A representative sample from the main cut on No. 10 vein assayed: gold, 0·02 ounce a ton; silver, 9·07 ounces a ton; lead, 1·02 per cent; zinc, 0·15 per cent.

Black Prince Vein. The vein known as the Black Prince is at elevation 1,940 feet and is 1,000 feet northeast of the No. 9 vein or 1,700 feet northeast of the shaft on the main vein. It strikes north 55 degrees east and dips 60 degrees southeast. It is explored by one open-cut and by a 50-foot shaft recorded as sunk in 1911. The vein is 18 inches wide on the surface and carries about 3 per cent of sulphide, mostly pyrite. A rough channel sample taken across the vein 50 feet south of the shaft assayed: gold, 0·04 ounce a ton; silver, 7·46 ounces a ton; lead, 1·07 per cent; zinc 1·12 per cent. The Minister of Mines report for 1915 states that 15 tons of ore from this shaft were shipped that year.

On the east side of the mountain, 1,100 feet southeast of the Black Prince vein, two short adits were driven in 1911 to explore small veins. The lower adit, at elevation 1,900 feet, is driven 25 feet west along an 18-inch vein that strikes west and dips 55 degrees north. . At the face of the adit the vein is cut off along a strong cross fault striking north 52 degrees east and dipping 75 degrees southeast. The vein carries an average of 5 per cent of pyrite and arsenopyrite throughout, and at the portal a pile

of hand-sorted ore was seen containing up to 30 per cent of galena, sphalerite, and tetrahedrite. An 18-inch channel sample taken across the vein in the roof of the adit, 10 feet from the face, assayed: gold, 0·01 ounce a ton; silver, 0·21 ounce a ton; lead, nil; zinc, nil. A grab sample from the ½-ton pile of hand-sorted ore on the dump assayed: gold, 0·10 ounce a ton; silver, 94·70 ounces a ton; lead, 10·68 per cent; zinc, 9·70 per cent.

The other adit, 25 feet higher and 90 feet farther south, is driven 97 feet west into the mountain. Fifty feet from the portal a sparsely mineralized vein is cut, which strikes north and dips 65 degrees east. A 6-inch, flat-lying branch vein is followed in the adit to where it is faulted at the face.

Babine Group (19)

The Babine claims are on the north side of Four Mile Mountain, 3 miles north of New Hazelton. An old trail leads north to the prospect from the north end of the road to the Mohawk mine. The claims have been neglected since about 1912.

At elevation 2,000 feet a 15-inch quartz vein occurs along a fault fissure in grey, coarsely crystalline granodiorite. The vein is exposed at the surface in a small open-cut 35 feet above the portal of an adit that is driven southwest to the vein. The entrance to the adit is now blocked by a cave in. In the open-cut the vein carries about 3 per cent of sulphide, chiefly galena. On the rock dump at the portal of the adit, there is about 10 tons of ore consisting of banded sphalerite and galena in a quartz gangue with a little chalcopyrite. The vein strikes south 50 degrees west and dips 65 degrees southwest.

A 15-inch channel sample taken across the vein in the open-cut assayed: gold, a trace; silver, 2·27 ounces a ton; lead, 2·65 per cent; zinc, nil. A representative sample collected from the 10-ton stock of hand-sorted ore assayed: gold, a trace; silver, 7·69 ounces a ton; lead, 11·02 per cent; zinc, 5·94 per cent; antimony, 0·25 per cent; copper, 0·84 per cent.

Roughly 500 feet farther east, a second adit has been driven south to explore another quartz vein in the granodiorite. The portal of this adit is also blocked by a cave in and all vein exposures are concealed by slumping in of the open-cuts. Some of the grey granodiorite on the rock dump is sheared and altered, and is impregnated with fine seams of pyrrhotite. A representative sample of this rock comprised of thirty chips picked at random from the dump assayed: gold, a trace; silver, nil. A sample of ore representative of a small amount scattered on the dump assayed: gold, 0·06 ounce a ton; silver, 2·25 ounces a ton; lead, 3·42 per cent; zinc, 9·00 per cent; antimony, 1·14 per cent.

Erie Group (Mohawk Mine) (20)

References: Ann. Repts., Minister of Mines, B.C.: 1909, p. 84; 1910, p. 87; 1911, p. 102; 1914, p. 200; 1920, p. 87; 1925, p. 133; 1927, p. 132; 1928, p. 156; 1929, p. 158. Geol. Surv., Canada, Sum. Repts.: 1909, p. 66; 1912, p. 103.

The Erie group of four Crown granted claims is on the west side of Four Mile Mountain, about 5 miles by motor road east from Hazelton. The original owner, E. L. Kinman of Vancouver, carried out small-scale development operations between 1909 and 1914, and commenced the

driving of the main crosscut adit at elevation 2,000 feet. This adit was continued in 1920 from the 200-foot mark to nearly 500 feet. Some drifting was done on the main vein by W. S. Harris in 1925 and by E. G. Brown in 1927. The property was optioned to Federal Mining and Smelting Company for a short time in 1928. Mohawk Mining Company, Limited, continued underground development work in 1928 and shipped 69 tons of hand-sorted and hand-jigged silver- lead- zinc ore. An additional 30 tons of ore was shipped in 1929. Operations were suspended in the autumn of 1929 after completing 745 feet of crosscutting and 940 feet of drifting in the main adit, with a 175-foot air raise to the surface at a point 885 feet from the portal. Above the main adit a 38-foot shaft was sunk on the main vein, with a 130-foot drift and two small stopes. Another shaft, now water filled but reported to be 50 feet deep, was sunk on an upper vein at elevation 2,225 feet, about 850 feet northeast of the 38-foot shaft.

The veins occur along faults in intensely altered and recrystallized tuff and sandstone beds, which are intruded by coarsely crystalline, grey granodiorite (*See* Figure 6). Frequently the veins lie in faults along the contact of the altered sediments and the intrusive granodiorite or in the altered sediments close to the granodiorite, and narrow after a few feet on entering the intrusive. The granodiorite is part of the boss-shaped body 1 mile in diameter that forms Four Mile Mountain. The main workings are in the tip of a tongue-like body of the altered sedimentary rocks that extends eastward into the granodiorite. The shape of this body is open to question, but judging from the surface outcrops and the underground exposures it is approximately 500 feet across from north to south in the vicinity of the workings and its outline is indented by abundant apophyses of the granodiorite. The sediments are also cut by a few small dykes of biotite aplite, which are exposed in the main adit. Three veins striking northeast and dipping from 30 to 65 degrees southeast are prospected by the workings in the tongue-like body of altered tuff and sandstone. A fourth vein, also striking northeast and dipping about 60 degrees southeast, is prospected by a shaft and trenches in an isolated body of altered tuff about 800 feet northeast of the main vein exposure. The veins range from 4 inches to 4 feet in width and from 100 to 450 feet in length. They are composed of a gangue of banded quartz and siderite, for the most part very sparsely mineralized, but there are a number of small, rich ore shoots of erratic distribution. The ore minerals in order of abundance are, jamesonite, sphalerite, pyrite, galena, and tetrahedrite. Assays show a high silver content and appreciable amounts of antimony in the high-grade shoots, in addition to lead and zinc.

The main vein is exposed by trenches and open-cuts for 210 feet along the surface at elevation 2,080 feet. To the southwest the vein terminates at a cross fault that strikes north 80 degrees east and dips 30 degrees southeast. The fault is at the east end of a 140-foot rock trench 12 feet deep in the altered sediments. Thirty feet north of the fault, a shaft inclined at 65 degrees is sunk 38 feet on the vein. From the bottom of the shaft a drift follows the vein northeast for 130 feet. The vein ranges in width from 12 inches at the shaft to 4 feet at the north face of the drift. The quartz gangue carries from 2 to 10 per cent

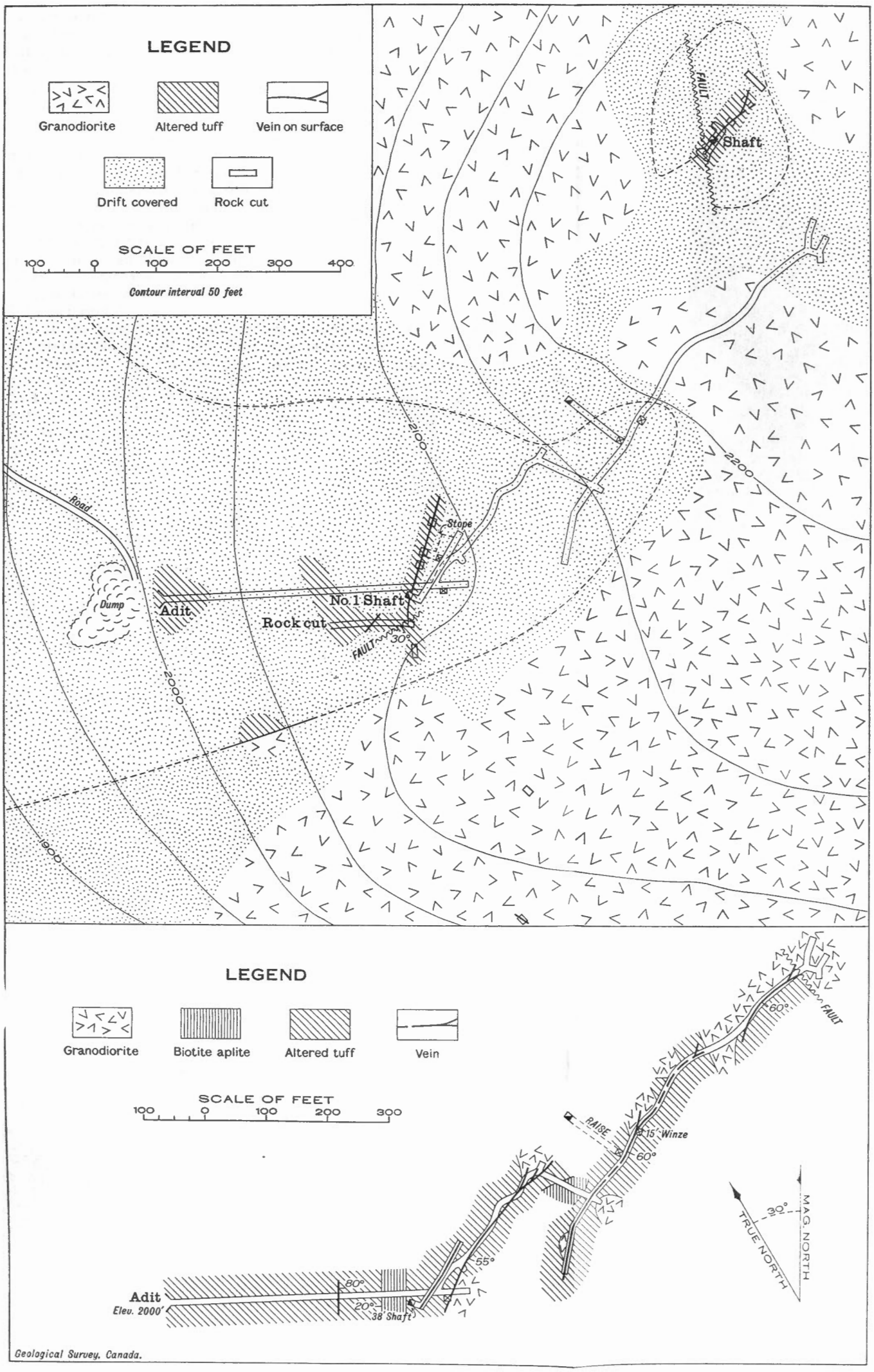
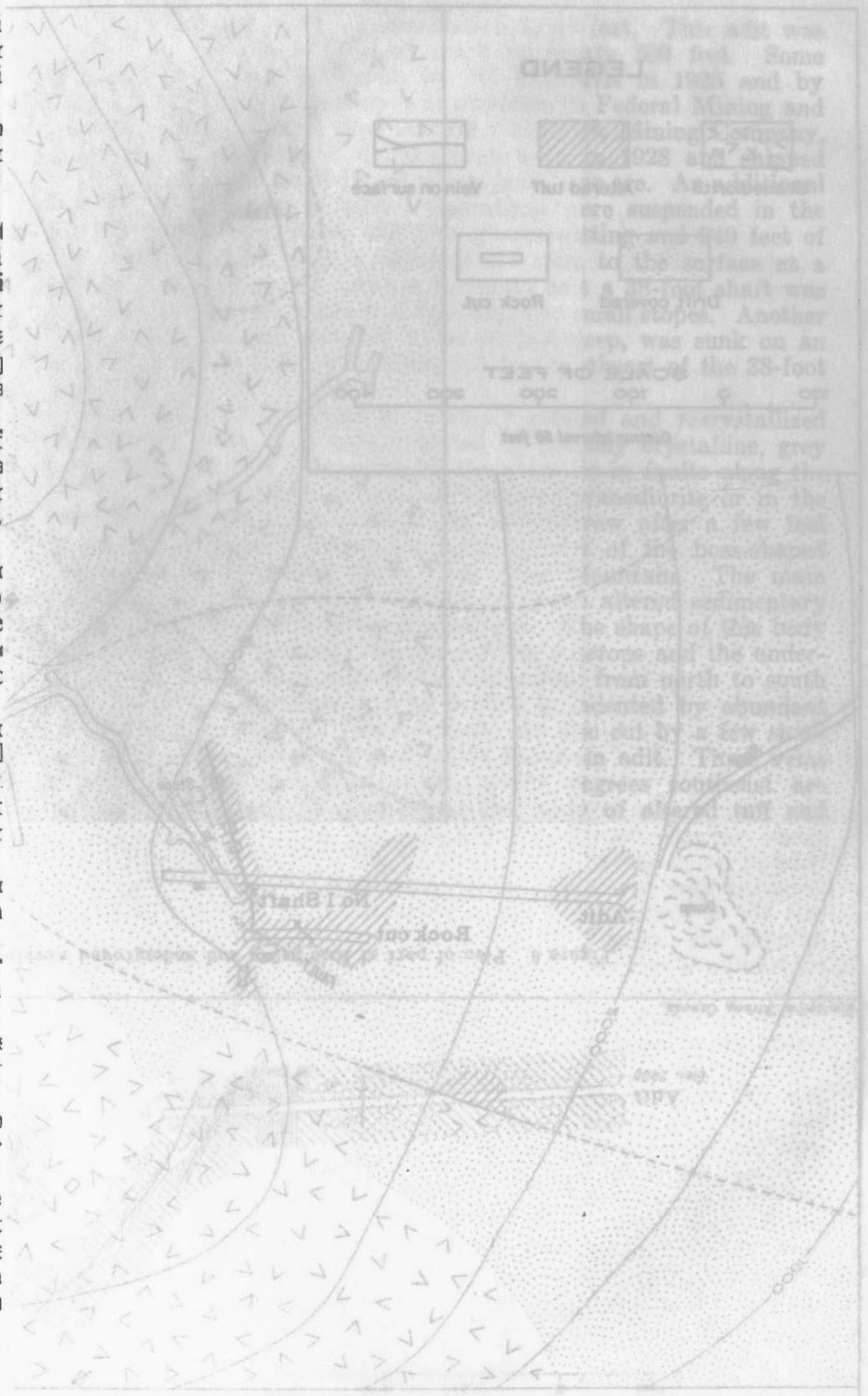


Figure 6. Plan of part of Erie group and underground workings at Mohawk mine.



of jamesonite, sphalerite, galena, and tetrahedrite. The vein is stoped out above this level for 40 feet along the vein, beginning 65 feet north of the shaft. Along the surface the vein ranges from 1 to 3 feet in width and carries disseminated sulphides, with occasional narrow seams of high sulphide content within the wider vein. In a rock cut 45 feet north of the shaft the vein consists of 16 inches of vein quartz with a 4-inch seam near its centre, rich in sulphides. A sample from the 4-inch seam assayed: gold, 0·01 ounce a ton; silver, 38·6 ounces a ton; lead, 7·24 per cent; zinc, 15·04 per cent; antimony, 0·25 per cent; arsenic, 0·14 per cent. In a pit 30 feet farther northeast the vein carries about 3 per cent of sulphides throughout its width of 30 inches, and there is in addition a central 3-inch sulphide seam. In the most northerly pit, 130 feet north of the 38-foot shaft, the vein consists of about 50 per cent quartz and 50 per cent brecciated, altered, tuffaceous wall-rock, containing about 5 per cent of sulphides. A 30-inch channel sample taken across the vein in this pit assayed: gold, 0·01 ounce a ton; silver, 1·73 ounces a ton; lead, 0·41 per cent; zinc, 0·56 per cent; antimony, 0·25 per cent; arsenic, 2·37 per cent.

In the long crosscut adit driven at elevation 2,000 feet, the main vein is intersected at 450 feet from the portal and a drift runs northeast following the vein for 260 feet. At the crosscut intersection the vein is sparsely mineralized. Sixty feet northeast along the drift the vein widens to 4 feet of quartz, 18 inches of which carries about 2 per cent of sulphide, with a central 3-inch seam containing better than 50 per cent of sulphide. An 18-inch channel sample taken across the mineralized part of the vein assayed: gold, a trace; silver, 0·24 ounce a ton; lead, 0·05 per cent; zinc, a trace; antimony, a trace. Forty feet farther northeast, the vein has narrowed to 5 inches of quartz carrying about 50 per cent of grey sulphides, chiefly jamesonite. A 5-inch channel sample taken across the vein at this place assayed: gold, 0·01 ounce a ton; silver, 18·33 ounces a ton; lead, 4·44 per cent; zinc, 8·33 per cent; antimony, 2·13 per cent; arsenic, nil. Another 40 feet northeast the vein has widened to 2 feet of quartz and carries only a sparse mineralization, chiefly sphalerite. One hundred and ninety feet northeast of the crosscut, there is an ore shoot 12 inches wide and 25 feet long containing about 50 per cent of jamesonite and sphalerite. A 12-inch channel sample taken here across the vein assayed: gold, 0·015 ounce a ton; silver, 14·67 ounces a ton; lead, 6·90 per cent; zinc, 9·75 per cent; antimony, 1·39 per cent; arsenic, 0·42 per cent. Near the end of the drift, the vein splits into three parts, two of which die away on entering a tongue of granodiorite, and the third, 6 inches in width, continues northeast into the wall, along the faulted contact between granodiorite and altered tuff.

No. 2 vein lies 100 feet east of the No. 1 vein, and is reached by a crosscut from the north end of the drift on No. 1 vein. The vein is followed by drifting for 138 feet southwest and 300 feet northeast from the 100-foot crosscut. In the south drift, the vein maintains an average width of 1 foot, but is sparsely mineralized. Fifty feet south of the crosscut some of the best-looking vein gangue carries about 5 per cent of jamesonite and sphalerite. An 11-inch channel sample taken across the vein at this point assayed: gold, a trace; silver, 2·14 ounces a ton; lead, 5·35 per cent;

zinc, 0·25 per cent; antimony, 0·98 per cent; arsenic, 0·12 per cent. Eighty feet northeast of the crosscut, a raise is driven up 175 feet to the surface. At the foot of the raise and continuing for 75 feet to the northeast, the vein ranges from 3 to 12 inches in width and the quartz gangue is well mineralized with jamesonite. A typical 4-inch channel sample taken across the vein at the foot of the raise, consisting of about 60 per cent sulphide and 40 per cent quartz, assayed: gold, a trace; silver, 14·67 ounces a ton; lead, 6·90 per cent; zinc, 9·75 per cent; antimony, 4·01 per cent; arsenic, 0·05 per cent. For 100 feet at its northeast end, the vein is very sparsely mineralized and in a number of places the fault fissure contains no vein filling whatsoever. Two hundred feet north of the raise, the vein splits and one branch, consisting of 12 inches of sheared tuff veined with quartz and siderite, passes into the north wall of the drift. The east branch is drifted along, but ends suddenly where the drift enters a body of granodiorite.

The drift continues 60 feet northeast from the end of No. 2 vein through granodiorite, then follows No. 3 vein for 120 feet along the fault contact between granodiorite on the northwest and altered tuff on the southeast to where the vein ends abruptly against a strong cross fault and sheared zone that strikes north and dips 75 degrees east. The vein has an average width of 6 inches and is generally only sparsely mineralized, but in several places carries from 3 to 5 per cent of jamesonite and pyrite.

No. 4 vein lies approximately 800 feet northeast of the main vein at elevation 2,225 feet. It is enclosed in a small body of fine-grained, recrystallized, tuffaceous rock. The vein is 100 feet long and ranges from 4 feet in width at its southwest end to 4 inches in width at its northeast end. It is developed by a 50-foot shaft that follows the vein down on an incline of 65 degrees. Twenty feet south of the shaft the vein ends abruptly against a cross fault that brings in a V-shaped wedge of the main body of granodiorite along the strike of the vein. The quartz gangue is well mineralized in the wide part of the vein south of the shaft and for 40 feet north of the shaft, and carries up to 30 per cent of jamesonite, sphalerite, galena, and tetrahedrite. An 18-inch channel sample taken across the vein 12 feet northeast of the shaft assayed: gold, 0·01 ounce a ton; silver, 4·19 ounces a ton; lead, 8·38 per cent; zinc, 1·73 per cent; antimony, 3·84 per cent; bismuth, nil; arsenic, 0·87 per cent.

There are a few tons of hand-sorted ore piled on the rock dump at the main adit. A hand specimen of this ore, consisting of banded, finely crystalline jamesonite and sphalerite with fine stringers of argentite replacing the jamesonite, assayed: gold, 0·015 ounce a ton; silver, 116·06 ounces a ton; lead, 22·33 per cent; zinc, 7·98 per cent; arsenic, 0·61 per cent; antimony, 11·54 per cent; bismuth, nil; cobalt, 0·21 per cent. Another sample, composed of 50 per cent grey quartz replaced by jamesonite and with a few nodules of sphalerite, assayed: gold, 0·01 ounce a ton; silver, 49·26 ounces a ton; lead, 11·45 per cent; zinc, 3·40 per cent; arsenic, 0·06 per cent; antimony, 6·45 per cent; bismuth, nil; cobalt, 0·21 per cent.

Comet Group (21)

References: Ann. Repts., Minister of Mines, B.C.: 1920, p. 87; 1928, p. 158; 1929, p. 159.

This group of three claims is on the south side of Four Mile Mountain, 5½ miles east of Hazelton. The claims are reached by a road, 3 miles long, that joins the Hazelton highway at Twomile Creek. The property was first prospected by Tommy Stevenson and Jim Dyer about 1920 and work was

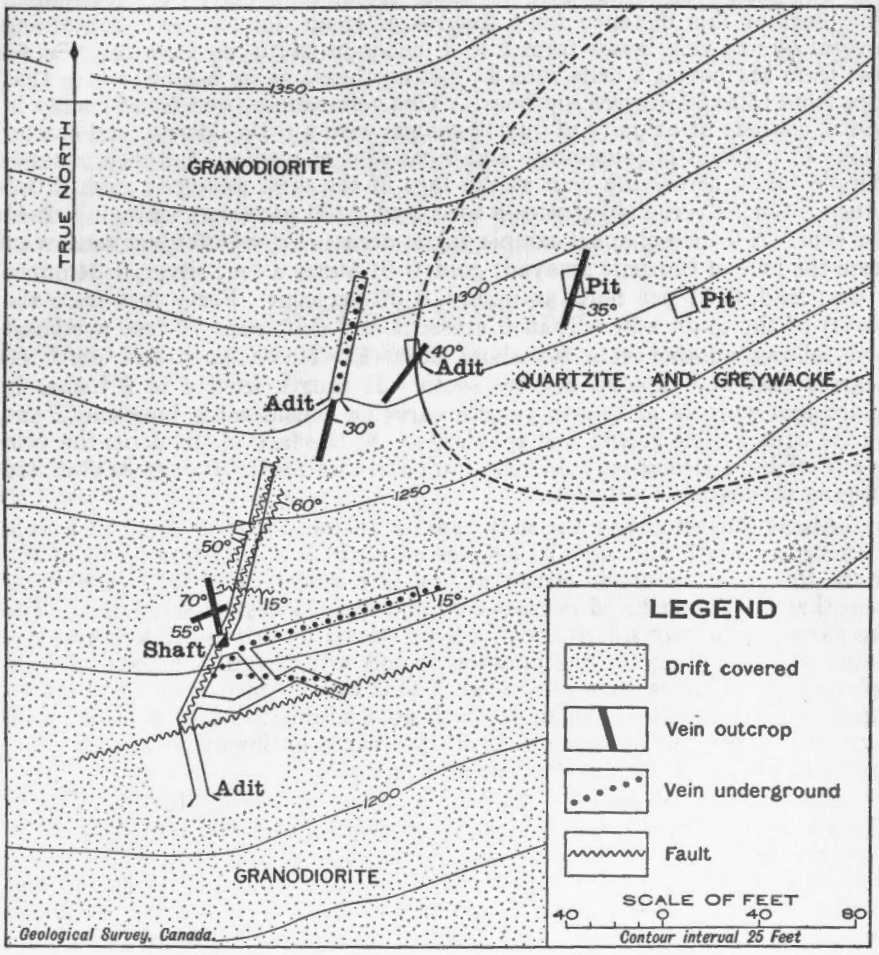


Figure 7. Plan of part of Comet group.

carried on periodically for several years. In 1929 small-scale operations were conducted by Bulkley Mines, Limited, but no work has been done since.

Massive, coarsely crystalline, grey granodiorite is exposed in the main workings (*See* Figure 7). The granodiorite is traversed by numerous intersecting fault planes and shear zones that strike chiefly from northwest to

northeast and dip from 15 to 60 degrees. Quartz veins occur along some of the fault fissures and sheared zones and contain variable amounts of jamesonite, sphalerite, galena, and pyrite. Jamesonite is the most abundant mineral present. Assays show that the jamesonite and galena are silver bearing. Some of the veins contain much siderite gangue, and those veins in and close to a body of quartzite and greywacke consist almost entirely of siderite holding jamesonite and sphalerite.

The main crosscut adit, at elevation 1,200 feet, is driven 147 feet north. For most of this distance fault fissures of small displacement containing several quartz vein lenses from 1 to 3 inches in width are followed. At 65 feet from the portal a drift runs 88 feet northeast along a quartz vein that dips from 15 to 30 degrees southeast. This vein ranges from 6 to 9 inches in width, consists principally of quartz gangue with a little siderite, and carries about 10 per cent of jamesonite and 5 per cent of pyrite. A 6-inch channel sample taken across the vein at the face of the drift assayed: gold, 0·015 ounce a ton; silver, 1·46 ounces a ton; lead, 5·36 per cent; antimony, 2·41 per cent. A 9-inch channel sample taken across this vein 60 feet southwest from the face of the drift assayed: gold, 0·01 ounce a ton; silver, 0·34 ounce a ton; lead, 0·51 per cent; antimony, 0·32 per cent. Forty feet from the portal of the main adit a branch crosscut and drift runs 70 feet northeast and follows another vein for about 35 feet. This vein strikes north 80 degrees east and dips 25 degrees south. It ranges from 4 to 9 inches in width and consists of quartz gangue carrying considerable jamesonite and pyrite with a little galena and sphalerite. At the face of the drift, the vein is cut off by a strong post mineral fault striking north 70 degrees east and dipping 60 degrees southeast.

About 30 feet above the main adit a 15-foot shaft is sunk on a vein that strikes north and dips 70 degrees east. In a cut 25 feet north of the shaft this vein is much richer at its intersection with a 3-inch cross vein that strikes north 55 degrees east and dips 55 degrees southeast. The ore gangue is largely siderite with a little quartz and the siderite is impregnated with finely crystalline jamesonite and with irregular masses of solid sphalerite. There is somewhat over 5 tons of ore piled near the shaft, a representative sample of which assayed: gold, a trace; silver, 78·69 ounces a ton; lead, 7·97 per cent; zinc, 12·95 per cent; antimony, 3·53 per cent; bismuth, nil; tin, 0·07 per cent; arsenic, a trace.

No. 2 adit, at elevation 1,275 feet, is 52 feet in length. It follows north along a quartz vein that strikes north 20 degrees east and dips from 30 to 50 degrees southeast. The vein ranges from 4 to 10 inches in width and is well mineralized with jamesonite and sphalerite, with a little galena and pyrite. Near the portal the jamesonite is spotted with a characteristic yellow oxidation product. At the portal a parallel fault fracture, which lies 4 feet above the vein, contains no vein matter. A 10-inch channel sample taken across the vein in the adit 11 feet from the portal assayed: gold, 0·01 ounce a ton; silver, 8·68 ounces a ton; lead, 1·22 per cent; zinc, 2·29 per cent; antimony, 0·47 per cent; bismuth, nil. Four feet from the face of the adit, a 4-inch channel sample taken across the vein assayed: gold, a trace; silver, 0·22 ounce a ton; lead, 0·36 per cent; antimony, 0·13 per cent; arsenic, 0·25 per cent.

A 10-foot adit 35 feet northeast of No. 2 adit is on the contact of the granodiorite with a body of sedimentary rocks extending to the east. The sediments are largely concealed by a light drift cover of sand and gravel. In the 10-foot adit a siderite vein passes from the granodiorite into impure quartzite. The vein ranges from 4 to 10 inches in width where exposed for 20 feet in the granodiorite, but pinches to 1 inch in a few feet on entering the quartzite. The vein is dark due to fine replacement of the carbonate by jamesonite. Sphalerite of resinous appearance is present in large, plum-like masses, and its colour blends with the rust from the oxidation of the siderite. A 6-inch channel sample taken across the vein at the portal of the adit assayed: gold, 0·005 ounce a ton; silver, 16·01 ounces a ton; lead, 7·82 per cent; zinc, 2·34 per cent; antimony, 3·68 per cent.

Seventy feet farther northeast a very similar carbonate vein ranging from 2 to 8 inches in width is exposed in an open-cut in greywacke. The vein strikes north and dips 35 degrees east. It is exposed for 60 feet along the slope. A 6-inch channel sample taken across the vein in the cut assayed: gold, nil; silver, 1·32 ounces a ton; lead, 5·67 per cent; zinc, a trace; antimony, 2·51 per cent; bismuth, nil; arsenic, nil.

Daley West Group (22)

References: Ann. Rept., Minister of Mines, B.C., 1916, p. 116. Geol. Surv., Canada, Mem. 110, 1919, p. 25.

The Daley West property is on the east side of Mission Creek, 2 miles south of New Hazelton. A wagon road was constructed to the property in 1916 and the Spokane Rocher Déboulé Mining and Copper Company explored the vein by driving two adits.

The claims are near the northern end of the porphyritic granodiorite boss that forms the core of Rocher Déboulé mountain. The granodiorite is a coarsely crystalline grey rock with conspicuous phenocrysts of brown biotite and light-coloured plagiaclase (zoned, ranging andesine to oligoclase) in a groundmass of quartz and orthoclase. A quartz fissure vein occurs in the granodiorite between elevations of 2,000 and 2,400 feet, following a strong fault plane. The wall-rocks are altered and silicified and bear sulphides over widths up to one foot. Both vein and wall-rock carry up to 50 per cent of pyrite and arsenopyrite with a little chalcopyrite, but the average sulphide content of the vein as a whole does not exceed 5 per cent.

The main adit, at elevation 2,175 feet, is driven 235 feet southerly along the vein. In the adit the quartz vein strikes south 30 degrees west and dips 65 degrees northwest. The vein has an average width of 6 inches, and with the additional mineralized wall-rock in many places approaches 3 feet in width. An 18-inch channel sample taken across the vein 45 feet from the portal of the adit assayed: gold, 0·06 ounce a ton; silver, 0·27 ounce a ton; copper, 0·05 per cent. A 7-inch channel sample taken 12 feet from the face of the adit, where the deposit is largely silicified and pyritized altered granodiorite, assayed: gold, 0·025 ounce a ton; silver, 0·38 ounce a ton; copper, 0·63 per cent. A 15-inch channel sample taken across the vein in the face of the adit assayed: gold, 0·04 ounce a ton; silver, 1·37 ounces a ton; copper, 1·92 per cent.

The lower adit, 125 feet vertically below the main adit, is now caved about the portal and could not be examined. It is described by O'Neill (1919) as follows.

"The lower tunnel is 155 feet long and follows two small stringers which are 2 to 3 feet apart and separated by partly decomposed granite; farther in the tunnel the stringers join and then separate as before. Each of the stringers carries an inch or two of chalcopyrite."

The vein is exposed at intervals above the main adit by four open-cuts on a 40-degree slope, the top cut being at elevation 2,300 feet. Above the topmost cut the vein is concealed by talus.

Hecla Claim (23)

The Hecla claim, owned by George Tallman of New Hazelton, is at the head of Station Creek on the north slope of Rocher Déboulé Mountain, 3 miles south of New Hazelton. It is reached by a good trail that follows the east side of the creek.

An altered aplite dyke 9 feet wide intrudes the granodiorite on the steep slope at the head of Station Creek. In an open-cut at elevation 3,900 feet the dyke strikes south up the slope and dips 75 degrees west. The dyke is cut by small quartz stringers over a width of 4 feet on the hanging-wall side, and the silicified rock is impregnated with a little pyrite and chalcopyrite. A representative sample of the mineralized rock assayed: gold, a trace; silver, 1·06 ounces a ton; copper, 0·22 per cent. At elevation 4,000 feet the 9-foot dyke is approached by a pegmatitic dyke about 6 feet wide. The pegmatitic dyke is prospected by an adit that extends 20 feet south as a crosscut with a 30-foot drift. The pegmatitic dyke is about flat-lying. It is bleached and somewhat altered, and is impregnated with a little disseminated pyrite and chalcopyrite. A representative sample of the mineralized rock collected from the face of the west drift assayed: gold, a trace; silver, 0·53 ounce a ton; copper, 0·39 per cent.

Golden Wonder Group (24)

References: Ann. Repts., Minister of Mines, B.C.: 1917, p. 107; 1918, p. 113. Geol. Surv., Canada, Mem. 110, 1919, p. 24.

The Golden Wonder group is at the foot of Rocher Déboulé Mountain, 4 miles south of New Hazelton and about 1 mile east of Carnaby railway station. The road to Comeau's ranch passes close to the workings.

Several narrow zones containing copper were discovered on this property by Harris and Comeau about 1914. Later the claims were secured by M. W. Sutherland, who in 1917 and 1918 put down a 100-foot shaft on the best looking vein. The claims reverted to the Crown some years ago.

Two parallel zones lying 115 feet apart have been traced by open-cuts for 200 feet across a low ridge on the southwest side of a small lake. The ridge is comprised of poorly bedded tuffs with some interbedded argillite. The strata strike south and dip 75 degrees west. The ridge trends in a direction somewhat east of north, and the zones strike north 85 degrees east

and dip from 65 to 75 degrees north. The fissured zones range from 1 to 3 feet in width and contain narrow sulphide lenses consisting largely of pyrrhotite with small amounts of pyrite, arsenopyrite, and chalcopyrite. At the surface the sulphide lenses are narrow and short. They do not exceed 6 inches in width and for the most part are less than 3 inches. A 100-foot shaft is sunk on the more northerly of the two zones. At the collar of the shaft the sheared zone carries very little sulphide, but during sinking operations some massive sulphide lenses were encountered containing considerable chalcopyrite. Some of the ore from the shaft is piled in two nearby heaps of about 20 tons. A representative sample from the smaller of the two piles assayed: gold, 0·20 ounce a ton; silver, 7·25 ounces a ton; copper, 6·50 per cent; nickel, none. The westerly continuation of this zone is exposed several hundred feet farther west on the side of the road. It has been trenched for 50 feet and is prospected by a shaft 30 feet deep. The shaft is sunk on two fissures from 2 to 3 feet apart. One fissure ranging from 3 to 6 inches in width consists largely of sheared rock sparsely mineralized. The other fissure carries a 3-inch sulphide vein at the surface, which increases in width to form a pyrrhotite lens 2 feet in width 10 feet down the shaft at the water-level. A representative sample taken from a small heap of pyrrhotite lying at the collar of the shaft assayed: gold, 0·04 ounce a ton; silver, 0·16 ounce a ton; copper, 0·30 per cent; nickel, none.

At the north end of the low ridge, 1,000 feet northeast of the 100-foot shaft, a narrow dyke of porphyritic diorite has been followed for about 150 feet by several open-cuts. In this vicinity the tuffs strike north and dip 40 degrees east. The dyke runs across the nose of the ridge, striking south 70 degrees east and dipping 75 degrees north. The dyke ranges from 8 inches to 4 feet in width. Short quartz lenses ranging from 0 to 10 inches in width lie along both walls. In some places the dyke is fractured along planes along the strike of the dyke and is traversed by small quartz stringers. The quartz carries a little pyrite and chalcopyrite. A representative sample of the mineralized quartz taken from the east open-cut assayed: gold, none; silver, 0·12 ounce a ton; copper, 0·79 per cent.

Cap or Comeau Group (25)

References: Ann. Repts., Minister of Mines, B.C.: 1914, p. 200; 1916, p. 90; 1917, p. 107; 1929, p. 155. Geol. Surv., Canada, Mem. 110, 1919, p. 23.

The Belton and Cap claims, owned by Denis Comeau, are on the northwest slope of Rocher Déboulé Mountain 4 miles south of New Hazelton. A good trail leads up to the property from Comeau's ranch at the foot of the mountain.

A little development work was done on a mineralized, sheared zone on this property, each year from 1914 until 1918. During 1917 a 29-ton shipment of ore was made to Ladysmith smelter, an average sample of which assayed: gold, 0·03 ounce a ton; silver, 10 ounces a ton; copper, 8 per cent. Some further work was done in 1929.

A brecciated and sheared zone crosses fine-grained tuffs. The sheared rock is partly replaced by siderite and a little quartz and is impregnated with considerable pyrite and a little chalcopyrite. It has been traced by

open-cuts and natural exposures for a distance of 350 feet between elevations of 2,165 and 2,225 feet. The zone strikes north 70 degrees east and dips from 70 to 80 degrees northwest. It ranges from 6 inches to 4 feet in width.

Near its northeast end a crosscut adit has been driven 76 feet southeast to the zone and a drift extends along the zone. At a distance of 27 feet southwest of the crosscut, a raise from the drift connects with No. 1 shaft. The distance from the collar of the raise to the floor of the adit is 35 feet. An ore shoot 30 inches wide, which was encountered during raising operations, furnished the ore shipped in 1917. According to the 1916 report of the Minister of Mines, B.C., an average sample taken across 30 inches in the raise at that time assayed: gold, a trace; silver, 3·2 ounces a ton; copper, 3·7 per cent.

On the surface the zone narrows northeast of the shaft. A 6-inch channel sample collected by the writer across the full width of the zone in an open-cut 25 feet northeast of the No. 2 shaft assayed: gold, 0·01 ounce a ton; copper, 2·05 per cent.

No. 2 shaft, 10 feet in depth, is 200 feet southwest of the No. 1 shaft. A heap of low-grade ore piled alongside the shaft consists of tuff replaced by siderite, quartz, calcite, and pyrite with a little chalcopyrite. Ten feet southwest of the shaft there is a 12-foot open-cut in which the sheared zone is 40 inches wide. A 40-inch channel sample taken across the zone in this cut assayed: gold, a trace; silver, 1·39 ounces a ton; copper, 0·05 per cent.

At elevation 1,975 feet, 440 feet southwest of No. 2 shaft, an adit is driven 206 feet in a northeast direction. The adit cuts a number of small mineralized fractures, none of which continues over 25 or 30 feet. Although the adit is on the line of strike of the main zone as projected from No. 2 shaft, it has evidently failed to intersect it. At No. 2 shaft the zone dips 70 degrees northwest, and as the adit is 190 feet below No. 2 shaft the zone should lie about 75 feet farther northwest at the adit level. This being so, a crosscut driven northwest from the face of the adit should intersect the sheared zone.

Hazelton View Group (26)

References: Ann. Repts., Minister of Mines, B.C.: 1916, pp. 89 and 114; 1917, p. 103; 1918, p. 112; 1925, p. 134; 1927, p. 132; 1928, p. 159. Geol. Surv., Canada, Mem. 110, 1919, p. 20.

The Hazelton View group is on the northwest slope of Rocher Déboulé Mountain 4 miles south of South Hazelton and 3 miles east of the railway. A pack-horse trail 3 miles long leads from Comeau's ranch at the foot of the mountain to the mine camp at elevation 4,100 feet. The workings are immediately above the camp between elevations of 5,100 and 6,025 feet.

The claims were acquired by New Hazleton Gold Cobalt Mines, Limited, in 1916, and were developed continuously until 1919. Two adits were driven and a tram-line constructed from the workings to the camp. During 1918 a carload of ore was shipped to the Ore Testing Laboratories, Mines Branch, Ottawa. The car contained 53,288 pounds dry weight of ore, which carried: gold, 1·24 ounces a ton; MoS_2, 1·40 per cent; MoO_3, 0·18 per cent; cobalt, 1·12 per cent; nickel, 0·60 per cent; arsenic, 8·98 per cent.

Further work was done in 1925, and the following year 22 tons of ore was shipped, which assayed: gold, 4·65 ounces a ton; arsenic, 42·3 per cent; cobalt, 4·6 per cent. The property was operated by Aurimont Gold Mines, Limited, during 1928 and an additional 23 tons of the gold-cobalt-arsenic ore was shipped.

The ore is essentially gold-bearing arsenopyrite, and occurs as shoots along a strong fault fissure in the grey, coarsely crystalline granodiorite boss that forms the core of the mountain. The fissure has been traced by open-cuts and adits for over 1,500 feet up a steep slope between elevations of 5,150 and 6,025 feet. It enters sedimentary rocks below 5,200 feet and is drift covered in that direction. The sediments are chiefly greywacke with some beds of garnetiferous argillite. At elevation 6,025 feet the fissure passes over the peak of the mountain and down into the Juniper Creek side of the divide. The fissure strikes east and dips from 45 to 60 degrees north. It ranges from a few inches to 3 feet in width of sheared and altered granodiorite, and where ore shoots occur this material is replaced by some quartz and hornblende and metallic minerals, which in order of their abundance are: arsenopyrite, safflorite, molybdenite, and chalcopyrite. Gold occurs as small grains scattered through the arsenopyrite and safflorite, and a small amount is also present in the quartz.

No. 1 adit at elevation 5,200 feet is 540 feet long. The fissured zone is intersected 55 feet from the portal and is followed for 485 feet east to the face of the drift. For the first 200 feet the zone averages 12 inches in width. It consists largely of sheared granodiorite with much chlorite and considerable glassy quartz, and contains occasional small seams of arsenopyrite and safflorite. A 12-inch channel sample taken across a particularly rich-looking part of the zone containing a 2-inch seam coloured with crimson cobalt bloom, 150 feet from the portal, assayed: gold, 2·04 ounces a ton; silver, 0·26 ounce a ton; nickel, 0·02 per cent; cobalt, 1·81 per cent. Midway along the drift the fissuring pinches to a single fault line marked by vertical striæ, but widens again within 50 feet. For 200 feet at the east end of the drift the width of shearing and alteration ranges from 1 to 3 feet, but the altered rock contains very little quartz or sulphide. A 12-inch sample of the altered granodiorite, collected 150 feet from the face, assayed: gold, a trace; silver, a trace.

No. 2 adit, at elevation 5,450 feet, is 475 feet distant from No. 1 adit up a 31-degree slope. It follows the fissuring for 725 feet. At 375 feet from the portal a raise goes up 100 feet, from which a drift runs 85 feet west, and at 450 feet from the portal a 25-foot winze is sunk in the zone. For 120 feet from the portal, the zone ranges from 6 to 12 inches in width and consists mostly of rusty gouge with occasional bands of glassy quartz. A short raise is driven up 75 feet from the portal, from which some ore was mined. From 120 to 170 feet along the drift, there is an open fissure 6 to 12 inches wide with neither gouge nor vein filling. Beyond the open part the fissured zone is normal, consisting of from 6 to 12 inches of brecciated, altered granodiorite with very little quartz and occasional small sulphide seams. At 230 feet from the portal the zone is offset 5 feet southeast by a cross fault. An 8-inch channel sample collected across the zone a few feet east of the fault, where there was considerable calcite, assayed: gold,

0·015 ounce a ton; silver, 6·53 ounces a ton. A 6-inch sample taken across 3 inches of quartz and 3 inches of chloritized altered rock 50 feet farther east assayed: gold, 0·03 ounce a ton; silver, 2·40 ounces a ton. For 400 feet from the face a lamprophyre dyke follows along or close to the zone. The dyke is brecciated and altered where it crosses the fissuring, so that in places it forms part of the gangue along with the altered granodiorite. Towards the east end of the drift the zone contains very little quartz or sulphide and is probably barren.

A third adit, reported to have been driven 170 feet along the zone at elevation 5,850 feet, was concealed by snow when visited in June. Some ore of good grade is said to have been taken from this adit. Ore was also mined from an open-cut 30 feet long, 3 feet wide, and 10 feet deep on the top of the ridge at elevation 6,025 feet.

Lone Star Claim (27)

The Lone Star claim is on Rocher Déboulé Mountain 6 miles southeast of New Hazelton. The workings are on Pangea Creek, the south fork of Mudflat Creek. The owner, Angus White of New Hazelton, has constructed an excellent branch trail to the claim from the Mudflat Creek trail to the Black Prince group.

At elevation 3,950 feet, a pyrrhotite vein is prospected by an open-cut on the southwest bank of the creek. The vein ranges from 1 to 4 inches in width and is less than 25 feet long. An adit driven 145 feet in a southerly direction along the strike of the vein does not disclose any mineralization. At distances of 175 and 475 feet, respectively, farther up the creek, 30-foot and 20-foot adits are driven into the southwest bank of the creek along small fissures, but likewise disclose no mineralization.

The rocks exposed along the banks of Pangea Creek, and on the steep slopes towards the west, are bedded sediments, composed of greywacke, slate, and argillite. They are intruded near the workings by several small dykes of porphyritic diorite and by a large body of granodiorite 1 mile to the west. Massive, grey, porphyritic andesite flows outcrop a short distance east of Pangea Creek and extend easterly to the Bulkley. Both sediments and volcanic rocks are flat-lying on this claim, and are in fault contact a short distance east of Pangea Creek. This north-trending fault is several miles in length. It is exposed on the steep south slope of Porphyry Creek and on the ridge on the north side of Mudflat Creek. The possible occurrence of veins along it has not been investigated, as it is largely drift covered.

MacDonald Property (28)

References: Ann. Repts., Minister of Mines, B.C.: 1926, p. 126; 1930, p. 139.

The Black Pilot, True Blue, and Summit claims, staked by Dan MacDonald in 1926, are between the head of the south fork of Mudflat Creek and the head of Porphyry Creek, 7 miles southeast of New Hazelton. The claims are reached by a poor trail that extends up the south fork of Mudflat Creek from the Lone Star property.

On the divide between the south fork of Mudflat (Pangea) Creek and Porphyry Creek, a pyrite vein was prospected by a 25-foot adit some years ago. The vein occurs along the contact of a lamprophyre dyke with argillites. It is lenticular and less than 25 feet in length.

At elevation 5,100 feet on the north side near the head of Porphyry Creek, pyritized argillite beds interstratified with greywacke and shales, which also contain a little finely disseminated pyrite, are prospected by several open-cuts and by a short, inclined shaft. In the vicinity the sediments strike west and dip 10 to 15 degrees north. They are intruded by several dykes of granodiorite, and the granodiorite stock that forms the core of the mountain lies a quarter of a mile to the west. Samples of the pyritized rock assayed only a trace in gold and silver.

Black Prince Group (29)

References: Ann. Repts., Minister of Mines, B.C.: 1913, p. 107; 1914, p. 205; 1916, p. 117; 1918, p. 113. Geol. Surv., Canada, Mem. 110, p. 25; Sum. Rept. 1924, pt. A, p. 45.

The property is on Rocher Déboulé Mountain, 6 miles south of New Hazelton at the head of Mudflat Creek. A branch road 1 mile in length leaves the highway 5 miles southeast of New Hazelton and runs to the foot of the mountain, from where a pack-horse trail 5 miles long follows up the north side of Mudflat Creek Valley to the prospect. The cabin is on a flat bench at elevation 4,150 feet, between two small lakes, and the workings are a short distance to the south on higher ground. This group is owned by Mrs. B. Sargent of New Hazelton.

A sheared zone containing tungsten and a little molybdenite occurs in the granodiorite about 1,500 feet southwest of the contact of the intrusive with sedimentary rocks lying to the northeast. The zone outcrops on a 45-degree slope between elevations of 4,650 and 5,000 feet. Below 4,650 feet it is covered by talus and above 5,000 feet it follows along the top of a flat ridge for about 500 feet. For the first 100 feet along the ridge it is exposed by three open-cuts, but for the next 400 feet is covered by talus and then outcrops in a steep bluff. The zone strikes south 30 degrees east and dips from 50 to 65 degrees southwest. The sheared zone ranges from 1 to 8 feet in width and contains from one to four parallel quartz veins ranging from 2 to 18 inches in width. The quartz veins and the sheared and altered granodiorite are mineralized with variable amounts of pyrite, chalcopyrite, molybdenite, and wolframite.

In the lowest cut at elevation 4,700 feet, there is a single sheared zone ranging from 1 to 3 feet in width. It is rust stained, and over a width of 6 inches along the hanging-wall side is impregnated with pyrite and a little molybdenite. In a large open-cut at elevation 4,950 feet the sheared zone is 5 feet wide. From east to west it consists of: 6 inches of sheared granodiorite replaced by quartz containing pyrite and molybdenite; 3 feet of altered granodiorite; 12 inches of sheared granodiorite replaced by honeycomb quartz from which considerable pyrite has been leached,

the rust-stained material contains nodules and crystals of wolframite up to 2 inches in diameter, the wolframite crystals are intergrown with quartz and are so rust stained that their presence might easily be overlooked; a narrow, porphyritic diorite dyke that pinches out at the top of the cut; a 3-inch quartz vein containing a little pyrite and chalcopyrite. The granodiorite along the hanging-wall side contains large sericite crystals, some of which are an inch in length. A 12-inch channel sample taken across the leached, rust-stained material alongside the dyke assayed: gold, 0·005 ounce a ton; silver, 5·93 ounces a ton; tungsten, 12·58 per cent.

In the main cut on the bench at elevation 5,000 feet, the zone consists of 18 inches of sugary, leached vein quartz containing about 2 per cent of molybdenite, 1 per cent of chalcopyrite, and 5 per cent of pyrite. An 18-inch channel sample taken across the leached vein material in this cut assayed: gold, a trace; silver, 1·64 ounces a ton; tungsten, none.

Highland Boy Group (30)

References: Ann. Repts., Minister of Mines, B.C.: 1912, p. 114; 1913, p. 107; 1914, p. 189; 1916, p. 109; 1917, p. 102; 1918, p. 113; 1919, p. 101; 1920, p. 87; 1921, p. 97. Geol. Surv., Canada, Mem. 110, 1919, p. 14.

The Highland Boy claims are immediately east of the Rocher Déboulé group, about 11 miles by road northeast from Skeena Crossing. The road follows the valley of Juniper Creek, keeping on the northwest side of the stream. The claims blanket a precipitous mountain ridge whose peaks rise to elevations exceeding 6,500 feet. This property was first prospected by Butte-Rocher Déboulé Copper Company, Limited, in 1912. The Delta Copper Company of Edmonton secured the property in 1917 and carried out some development work. In that year a shipment of 74·92 dry tons of ore was made to Ladysmith smelter, which returned 10,494 pounds of copper, 4 ounces of gold, and 35 ounces of silver. In 1919 and 1920 a little further work was done, and in 1921 Lynch Brothers of Spokane are reported to have done some diamond drilling. Since then nothing has been done on these claims.

A number of fissure zones occur on this property in the coarsely crystalline, grey granodiorite that forms the core of Rocher Déboulé Mountain. The two principal zones strike in an easterly direction and dip from 45 to 80 degrees north. One of these zones is an easterly continuation of the main upper zone on the Rocher Déboulé group. From the most easterly adit, at elevation 5,160 feet on the latter property, this zone extends east across the Timber Line, Iowa, and Coral Queen claims to the Highland Boy claim of the Highland Boy group. The length of this fissure approaches 1 mile across the two properties, but no work has been done on it east of the old adit on the Timber Line claim. Its outcrop is largely concealed by talus. The main fissured zone of the Highland Boy group lies about 700 feet farther north. It has been followed for 3,500 feet in an easterly direction across the Delta Fraction, Balmoral, Zig Zag Fraction, and Golden Fleece claims. At its east and west ends, the outcrops are above an elevation of 5,700 feet. Midway along its strike, between elevations of 6,400 and 6,500 feet, the zone is almost inaccessible where it crosses sharp, jagged peaks.

Both zones occur along faults of marked displacement. The gangue minerals are chiefly hornblende, actinolite, chlorite, and quartz, with a little carbonate. Where faulting has caused much brecciation of the wall-rock the granodiorite fragments have been altered and replaced by the gangue and by metallic minerals. The widths of the ore shoots are determined by the amount of brecciation or shearing of the wall-rocks along the fault fissures. The metallic minerals are principally chalcopyrite, pyrite, and magnetite, and the ore carries small amounts of gold and silver.

At elevation 5,700 feet an adit has been driven north 45 degrees west along a fissured zone that dips 80 degrees north. The adit is now caved at the portal and the vein is concealed by talus. At elevation 5,875 feet, about 310 feet up the slope, a second adit has been driven north 45 degrees west. The portal of this adit is also blocked by a cave-in and the zone is hidden by talus. The main adit, at elevation 6,050 feet, about 350 feet farther up the slope has been driven 300 feet along the zone, with a 17-foot crosscut to the northeast and a 9-foot crosscut to the southwest from the end of the drift. In the adit the zone has an average strike of north 54 degrees west and dips 70 degrees north. At the portal a width of 4 feet of the granodiorite is traversed by ten parallel fractures with a sparse dissemination of chalcopyrite throughout, but the middle 18 inches is well mineralized, carrying up to 10 per cent of pyrite and chalcopyrite with a little magnetite. Thirty feet within the adit the vein pinches, and no further sulphides are seen until a 5-inch seam of almost solid pyrite, with some chalcopyrite, comes in on the south wall 70 feet from the portal. For the next 15 feet the vein strengthens, and between 87 and 105 feet from the portal the roof is stoped out for 10 to 15 feet up. At 100 feet from the portal a winze is reported by O'Neill (1919) to have been sunk for 30 feet. "In 12 inches of ore throughout this depth; at the bottom of the winze the ore was 12 inches wide at the east side and 26 inches wide at the west side, all of high grade".

This winze is now ice filled the year around. For 40 feet west of the winze the fissure traverses a lamprophyre dyke, and throughout this rock there is no vein filling. For the next 150 feet west, from the dyke to the crosscut, the fissured zone ranges from 3 inches to 2 feet in width and carries ore minerals for most of that distance. There is a stope from 114 to 131 feet from the portal. At the face of the drift, 300 feet from the portal, the zone is cut off by a cross fault that strikes northeast and dips 55 degrees northwest. The continuation west of the fault lies to the southwest.

Above the adit the fissured zone is followed by several large open-cuts, to an elevation of 6,400 feet where it crosses the precipitous peak and cannot be followed. In one rock cut at elevation 6,340 feet, 500 feet west of the portal of the adit, the zone is 2 feet wide. It is much oxidized and leached at the surface, but much massive chalcopyrite shows in the bottom of the cut. The chalcopyrite is banded by seams of coarsely crystalline black magnetite and contains pyritohedral pyrite crystals up to 1 inch in diameter. Twenty feet west of this cut, a branch fissure joins the main vein. The branch fissure carries up to 24 inches of solid sulphides, chiefly chalcopyrite, for a distance of 30 feet from the main vein. Other exposures

were seen in the open-cuts between the cut just described and the portal of the adit. In most of these cuts the sulphides have been oxidized and are mostly leached out by surface waters.

A representative sample of the solid sulphide ore, collected from a small heap of ore stacked at the portal of the main adit, assayed: gold, 0·13 ounce a ton; silver, 0·73 ounce a ton; copper, 15·03 per cent. A 5-inch channel sample taken across the vein in the adit, 70 feet from the portal where the sulphide present is chiefly pyrite, assayed: gold, 0·015 ounce a ton; silver, 0·23 ounce a ton; copper, 2·50 per cent.

On the Delta Fraction claim the Highland Boy fissure zone is exposed on the northwest side of the steep mountain ridge between elevations of 5,900 and 6,000 feet. In an open-cut at elevation 5,950 feet the zone is 2 feet wide and it is abundantly mineralized with chalcopyrite. It strikes east and dips 50 degrees north. Between elevations 5,650 and 5,900 feet the smooth, striated foot-wall of the zone, along which the mineralization occurs, rises abruptly from a talus slope under which the deposit is concealed. Some of the gangue still clings to the foot-wall, but most of it has tumbled down the steep talus slide. At elevation 5,600 feet, an adit driven in below the zone extends 372 feet on an average bearing of north 60 degrees east. This adit lies parallel to the zone and 30 to 40 feet south of it. At 243 feet from the portal a crosscut runs 145 feet southeast, and from its end a branch crosscut extends 27 feet northeast. The zone would have been reached from the main adit by driving a crosscut northeast 30 or 40 feet.

There is evidence that a crosscut adit was driven towards the zone at an elevation of 5,856 feet, but this adit is now completely hidden by a talus slide.

Rocher Déboulé Mine (31)

References: Ann. Repts., Minister of Mines, B.C.: 1911, p. 80; 1912, p. 113; 1913, p. 107; 1914, p. 185; 1915, p. 77; 1916, pp. 106-108; 1917, p. 101; 1918, p. 111; 1928, p. 158; 1929, p. 155; 1930, p. 138. Geol. Surv., Canada, Mem. 110, 1919, pp. 7-14.

The Rocher Déboulé mine is on Rocher Déboulé Mountain about 6 miles south of New Hazelton. The property is reached by a road 10·5 miles in length, which leads northeast from Skeena Crossing along the north side of Juniper Creek to the mine camp at elevation 4,000 feet. There are nine claims in the group, the Jack Pine, Timber Line, Iowa, Balsam Fraction, Balsam, Juniper, Third Fraction, Joe Fraction, and Log Cabin. Munroe and Sargent, original locators, transferred the property to Rocher Déboulé Copper Company, Limited, of Salt Lake City in 1911. During the next 2 years two strong fissure zones were explored by adit drift and considerable copper ore was blocked out. In 1914 Montana Continental Development Company, of Butte, Montana, secured a 2 years' lease on the mine. They installed a small hydro-electric plant on Juniper Creek 5 miles above Skeena Crossing. A 12-drill compressor was set up at the lower adit at elevation 4,100 feet and an inclined surface tram was run up to the No. 4 adit at elevation 5,050 feet. A small gauge railway half a mile in length

was installed at elevation 5,040 feet to carry the ore across the mountain from the bunkers to an aerial tramway that took the ore down to the railway at Tramville.

In 1915, from May 17 to December 12, 17,000 tons of ore was shipped to Granby smelter at Anyox, averaging 8 per cent copper, $1.65 in gold, and 50 cents in silver to the ton. In 1916, mining was carried on by the Rocher Déboulé Mining Company, production being 16,800 tons of ore shipped containing 1,200 ounces of gold, 16,700 ounces of silver, and 1,619,145 pounds of copper. Smaller ore shipments were made the following 2 years, but in October 1918 all mining operations were suspended. From April 1915 until October 1918, the mine produced 39,833 tons of ore containing 4,214 ounces of gold, 62,865 ounces of silver, and 5,746,306 pounds of copper.

In 1929, Aurimont Mines, Limited, took an option on the property and shipped 72 tons of hand-sorted ore, which assayed: gold, 0·14 ounce a ton; silver, 40 ounces a ton; copper, 4 per cent. A little further work was done in 1930 by Hazelton Copper Mines, Limited, under W. S. Harris.

The claims are on the west contact of the granodiorite stock that forms the core of Rocher Déboulé Mountain. The granodiorite is a coarsely crystalline, mottled grey rock composed of 10 per cent orthoclase, 60 per cent andesine, 10 per cent quartz, 10 per cent biotite, and 10 per cent hornblende, with a little magnetite. The contact of the intrusive with sandstones, argillites, and tuffaceous sediments runs northerly across the west boundary of the property. The granodiorite is traversed by a number of strong fissure zones that outcrop on the mountain slope, the lowest being at an elevation of 4,400 feet and the highest at 5,300 feet. The zones strike easterly and dip from 35 to 65 degrees north into the mountain. The lowest vein extends westerly for a short distance from the granodiorite into the bedded rocks, but the others lie entirely within the granodiorite. They range from several hundred to several thousand feet in length and from 4 inches to 8 feet in width. They were formed by shearing along fault lines, and the crushed and brecciated granodiorite along the faults acted as channels for the rising mineralizing solutions. The deposits are valuable for their copper content, but economic amounts of gold and silver are also present. The zones commonly carry only a low grade of milling ore and in some places are barren. Two of the zones, the lowest and the highest, were found to carry ore shoots of high-grade copper ore. O'Neill (1919) states that in the upper part of the highest vein there were four large bodies of high-grade copper ore of irregular shape at approximately the same elevation, but separated horizontally by 50 to 200 feet of material carrying much lower values, and in places no values at all.

The granodiorite is intruded by several kinds of dykes. One is a fine-grained, grey, quartz diorite dyke 50 feet wide, which strikes a little east of north through the mine workings and dips 55 degrees northwest. This dyke was intruded prior to fissuring and is offset where it crosses the zones. Small porphyritic diorite dykes were intruded subsequent to the fissuring, but prior to mineralization. Some of these dykes, only a few inches in width, were seen along minor fissures west of the upper ore bunkers. The dykes are bordered on both sides by quartz and hornblende vein-gangue. A 3-foot dyke of porphyritic diorite outcrops on the south side of the upper-

most vein about 200 feet west of the Delta surface tram, but its relation to the vein is obscured by drift cover. Lamprophyre dykes intrude the granodiorite on the Delta property and are older than the deposits.

The primary fissuring was followed by alteration of the brecciated granodiorite along the fissures. Alteration was accompanied by a notable development of hornblende and actinolite, and the introduction of considerable quartz. Following renewed movement along the fissures, the fractured gangue and the hornblende, actinolite, quartz, and altered granodiorite were replaced by variable amounts of the ore minerals. The hornblende gangue was particularly susceptible to replacement by chalcopyrite, and the richest ore taken from the mine was of this type. The chalcopyrite-hornblende ore contains, in addition to the chalcopyrite and hornblende, variable amounts of magnetite, pyrrhotite, arsenopyrite, pyrite, tetrahedrite, safflorite, and molybdenite. The quartz in this type of ore is glassy and is without banding. There are very subordinate amounts of calcite and siderite in the ore.

Further movement was followed by the formation of banded, milky white quartz veins. These veins traverse the chalcopyrite-hornblende ore or lie along either the hanging- or foot-wall side of the fissure zones. The banded quartz carries sufficient galena, sphalerite, and tetrahedrite to make a good grade of silver-lead ore. It also carries pyrite, arsenopyrite, and chalcopyrite, but only in minute amount. The silver-lead ore is, however, relatively unimportant, as the banded quartz veins seldom exceed half a foot in width or 100 feet in length.

The completed development work consists of more than 2 miles of crosscuts and drifts, 2,200 feet of raises, and 330 feet of winzes.

No. 1, the lowest or main crosscut adit at elevation 4,100 feet, is driven for about 3,100 feet northwest into the mountain and intersects four fissures with drifts on each. It is connected to the drift on the lowest fissure by two raises and stopes. The entrance to this adit has been sealed by a boulder slide that was brought down by a rush of water from No. 4 adit and these workings are not accessible.

No. 2 adit, at elevation 4,365 feet, extends northwest as a crosscut for 180 feet to the lowest fissure zone. From there the fissure is followed by a drift for 1,400 feet on an average bearing of roughly south 75 degrees west. The drift extends 1,340 feet west and 60 feet east from the crosscut. There are a number of raises and stopes in what were the richest parts of the fissure, but judging by the exposures in the roof of the drift, a considerable tonnage of low-grade ore remains.

An 18-inch channel sample was taken across the deposit in the roof of the drift 280 feet west from the main crosscut. Here the zone consists largely of brecciated granodiorite partly replaced by hornblende and chalcopyrite, but on the foot-wall side there is a 2-inch seam of milky white quartz carrying galena, sphalerite, and tetrahedrite. The 18-inch sample assayed: gold, 0·04 ounce a ton; silver 16·33 ounces a ton; copper, 3·35 per cent; lead, 8·24 per cent; zinc, 11·44 per cent. About 400 feet west of the crosscut a 28-inch channel sample taken across the zone in the roof of the adit assayed: gold, 0·095 ounce a ton; silver, 1·55 ounces a ton; copper, 5·53 per cent. This sample was of brecciated granodiorite only sparsely mineralized with chalcopyrite and is representative of a very

barren looking section of the fissured zone. About 250 feet farther west along the drift a 20-inch channel sample taken across the zone where the gangue included 30 per cent of sparsely mineralized quartz assayed: gold, 0·055 ounce a ton; silver, 2·55 ounces a ton; copper, 2·60 per cent. For 90 feet from the face at the west end of the drift, the zone traverses dark, fine-grained, argillaceous sediments. At the face, the zone consists of 4 inches of gouge only sparsely mineralized, but at the contact of the sediments and the granodiorite and for 70 feet west towards the face the zone consists of 6 to 15 inches of quartz carrying abundant chalcopyrite and safflorite, and is stained crimson by oxidation of the safflorite, to cobalt bloom. A 12-inch channel sample taken across this part of the vein, 15 feet west of the granodiorite contact, assayed: gold, 0·26 ounce a ton; silver, 2·25 ounces a ton; copper, 11·39 per cent; cobalt, 1·01 per cent; nickel, 0·02 per cent.

About 540 feet west along the drift from the crosscut to the zone, a crosscut runs 535 feet northwest to a second parallel zone. In an 85-foot drift to the west from the end of this crosscut this zone consists of from 6 to 20 inches of white quartz sparsely mineralized with pyrite. A 15-inch channel sample taken across the deposit in the roof of the adit, 35 feet west of the crosscut, assayed: gold, 0·01 ounce a ton. This zone dips 35 degrees north and, presumably, is represented at the surface by a quartz vein that outcrops for 50 feet at elevation 4,625 feet, a short distance below the air raise from the crosscut. Several small seams of solid chalcopyrite up to 3 inches in width occur in the outcrop. There has been a marked dislocation along this fissure, as a 50-foot dyke of quartz diorite that forms the south wall of the fissure at the end of the crosscut does not appear on the north side of the fissure in the present workings. A drift, which runs northeast from near the end of the crosscut, follows the fissured zone for 30 feet to where it ends at a body of fine-grained, greenish microdiorite. The drift continues 100 feet easterly in this rock, but does not pass through it. The microdiorite is not offset by the fissuring and, therefore, was intruded after the major fault movement, but as small quartz stringers penetrate the microdiorite it is evident that some fracturing and mineralization took place later than the intrusion of the microdiorite.

In a number of places along the drift on the main fissured zone, roughly horizontal fault striations were seen, indicating that at least the final movements were in a horizontal direction. The 50-foot dyke of quartz diorite ending against the northern of the two fissure zones is intersected by the southern fissure 350 feet east from the face of the drift, and exhibits an apparent horizontal displacement of only 6 feet. Where both sides of the fissure are bounded by this dyke rock there is no vein gangue.

No. 3 adit is 55 feet vertically above and 110 feet north of No. 2 adit. The workings consist of a 10-foot crosscut and a 100-foot drift along the main fissure zone, with midway along the floor a stope 20 feet long and extending down to the level of No. 2 adit. In No. 3 adit the zone ranges from 10 to 20 inches in width and carries from 1 to 10 per cent of chalcopyrite. Near the portal there is a short 4-inch seam of almost solid sphalerite. Numerous fragments of white quartz containing galena and tetrahedrite were seen on the dump at the portal. The zone outcrops for

over 100 feet eastward from the portal of No. 3 adit, but has not been prospected in that direction.

No. 4 adit is at an elevation of 5,050 feet, 100 feet from the junction of the inclined surface tram and the narrow gauge railway, and about 900 feet north-northwest from No. 3 adit. Most of the ore from the uppermost fissure zone was taken out by way of this adit. From the portal the adit runs as a crosscut about 675 feet northwest to the vein, and there is about 1,200 feet of drifting along the vein on this level. A winze was driven down 200 feet on a 60-degree slope and considerable drifting and stoping were done from that level. The adit is blocked 400 feet from the portal and, therefore, workings could not be examined during the 1937 season.

The portal of No. 5 adit is 900 feet northeast of No. 4 adit at an elevation of 5,160 feet. The uppermost main fissure outcrops a few feet above the portal and a smaller parallel vein lies 25 feet farther north. The adit was driven as a crosscut for 35 feet to the main fissure zone, with 700 feet of drifting along it to the southwest. In the drift the zone has an average strike of south 75 degrees west and dips from 60 to 65 degrees north. It is stoped out below this level for a length of 40 feet at the east end of the drift and for a length of 120 feet starting at a point 425 feet farther west. Above the latter opening, the roof of the drift is stoped for 80 feet along the strike of the zone. Another stope, which measures 50 feet along the strike of the zone, extends upwards at the west end of the drift and a little more high-grade ore was taken from a small stope 340 feet from the portal. At 140 feet west along the main drift, a crosscut, which runs 95 feet northwest, cuts a 6-inch fissure zone 30 feet northwest of the main zone. At 250 feet west along the drift, this second zone is intersected again by a 15-foot crosscut and considerable ore has been removed here in a 25-foot drift and stope. The northern zone at either end of the drift ranges from 3 to 4 feet in width and is well mineralized with chalcopyrite. On the south side of the main zone opposite the 15-foot crosscut a winze goes down and connects with the No. 4 adit workings.

For most of its length the remaining parts of the main zone where exposed in the roof of the adit average about 15 inches in width and carry from 1 to 3 per cent of chalcopyrite, but in some places the zone consists only of rusty, softened, altered granodiorite very barren in appearance. A 15-inch channel sample of this material taken from the roof of the adit 130 feet west along the drift assayed: gold, 0·05 ounce a ton; silver, 7·39 ounces a ton; copper, 7·17 per cent.

Neither the main zone nor the one lying 25 feet north of it has been prospected more than a short distance easterly from the portal of No. 5 adit. According to O'Neill's plan of the underground workings (Memoir 110, page 8), the east drift of No. 4 adit extends roughly 150 feet farther east to a large quartz diorite dyke. Presumably, drifting was stopped when the zone was found to pinch on striking the dyke, but judging from experience in other parts of the mine, the zone will be normal widths on the east side of this dyke. The main zone is exposed at intervals along the surface for over 1,500 feet in an easterly direction from No. 5 adit. Immediately east of the adit it is concealed by talus, but from a point

600 feet east of the adit, a small stream follows along the course of the zone for 500 feet. Only the foot-wall side on the south side of the stream is visible. In the few places exposed, the typical vein gangue of quartz, hornblende, and actinolite, mineralized with chalcopyrite and magnetite, was seen. A grab sample taken about 1,000 feet east of the No. 5 adit, or 190 feet west of the Delta inclined tramway at elevation 5,150 feet, assayed: gold, 0·005 ounce a ton; silver, 0·11 ounce a ton; copper, 0·77 per cent.

Great Ohio Group (32)

References: Ann. Repts., Minister of Mines, B.C.: 1911, p. 80; 1912, p. 114; 1913, p. 107; 1914, p. 188; 1915, p. 77; 1916, p. 113. Geol. Surv., Canada, Mem. 110, p. 18.

This group, staked by Sargent and Munroe in 1910, consists of seven claims, the Pilot, Great Ohio, Scotch Hill, Henrietta, Maple Leaf, Kitseguecla, and Princess. The property is near the head of Juniper Creek on the south side of the valley opposite the Rocher Déboulé mine. The camp, at elevation 3,950 feet, is 9½ miles by road northeast from Skeena Crossing. The claims were prospected between 1913 and 1916 by Messrs. Jennings and Trimble, who drove a long adit.

The property is astride the west contact of the granodiorite stock that forms the core of Rocher Déboulé Mountain. In the granodiorite, near its contact with sandstones and argillaceous sediments, a strong shear zone has been followed up the precipitous mountain slope for about 800 feet. There are several small open-cuts on it and narrow quartz lenses are exposed that carry small amounts of chalcopyrite, pyrite, galena, and sphalerite.

An adit, at elevation 4,500 feet, explores two subsidiary shear zones in the granodiorite, in addition to the one mentioned. One of these is followed for 355 feet from the portal on an average bearing of north 50 degrees east, and from the end of the drift a crosscut runs 190 feet southeast to the second shear zone and an additional 70 feet southeast to the main shear zone. The second shear zone is drifted along for 128 feet, and the main shear zone for 400 feet to the northeast. In each drift the sheared zone strikes north 50 to 55 degrees east and dips from 65 to 70 degrees northwest.

The most westerly shear zone, the one followed for 355 feet, ranges from 1 to 4 feet in width. There is much gouge and rust along the middle of the zone, but no vein quartz or concentration of sulphides were seen. An 18-inch hornblende lamprophyre dyke follows along the zone and has been sheared and brecciated where it crosses from the foot-wall to the hanging-wall side of the fissure.

The second shear, as seen in the 128-foot drift, ranges from 8 inches in width at the crosscut to 2 inches in width at the face of the drift. It consists of sheared granodiorite replaced by variable amounts of vein quartz, hornblende, and chalcopyrite. A 5-inch channel sample taken across a typical part of the vein 60 feet from the crosscut assayed: gold, 0·005 ounce a ton; copper, 0·62 per cent.

The main shear zone in the 400-foot drift has an average width of 20 inches. It consists chiefly of sheared and brecciated granodiorite with

much rusty gouge. In several places there is much hornblende associated with small quartz stringers that carry a little pyrite and chalcopyrite. A 12-inch lamprophyre dyke that closely follows the fissured zone is much altered and impregnated with pyrite. A 26-inch channel sample taken across the sheared zone on the southwest face of the drift at the crosscut assayed: gold, 0·01 ounce a ton; copper, 0·12 per cent. A 12-inch sample taken across the lamprophyre dyke on the foot-wall side of the vein, adjacent to the part of the zone represented by the 26-inch sample, assayed: gold, none; copper, 0·18 per cent. An 18-inch channel sample taken across the vein at the northeast face of the drift assayed: gold, none; copper, 0·12 per cent.

Spaulding Property (33)

This property is about 1 mile south of the Rocher Déboulé mine, which is 6 miles south of New Hazelton on Rocher Déboulé Mountain. It is reached by a trail that runs in a southerly direction from the Rocher Déboulé mine camp.

At elevation 4,250 feet an adit is driven northeast into the mountain in greywacke, argillite, and hornfels. A cave-in prevented examination of the adit and no vein was seen nearby. At elevation 4,475 feet a second adit 160 feet long is driven northeast in similar sedimentary rocks, which strike northeast and dip 40 degrees northwest. The adit discloses a number of small stringers up to 1 inch wide that lie parallel to the bedding. The stringers are composed of fine black magnetite and chalcopyrite.

Red Rose Group (34)

References: Ann. Repts., Minister of Mines, B.C.: 1914, p. 190; 1916, p. 113; 1926, p. 126. Geol. Surv., Canada, Mem. 110, 1919, p. 18; Sum. Rept. 1924, pt. A, p. 44.

The property is on the north side of Balsam Creek 8 miles east of Skeena Crossing station. It is reached from Skeena Crossing by following 7 miles east along the north side of Juniper Creek on the Rocher Déboulé mine road, then by branch pack-trail along the north side of Balsam Creek an additional 3 miles to the Red Rose cabin at elevation 5,000 feet. The claims are owned by Mrs. B. Sargent of New Hazelton.

The original group of five claims, staked by C. Peterson and C. Ek about 1912, were named as follows: Red Rose, Yellowhammer, Prosperity, Juniper, and Summit. In 1914, a syndicate headed by T. J. Vaughan-Rhys secured an option and drove two adit drifts at elevations of 5,450 and 5,690 feet on a sheared zone that contains a little gold and copper. At elevation 5,150 feet a crosscut adit was driven 430 feet to intercept the downward continuation of the sheared zone, but without success. In 1916 the Skeena Development Company continued the work, driving the adit at elevation 5,450 feet a total distance of 250 feet, and the upper adit a total distance of 160 feet along the sheared zone. Later the owners did a little surface work on a large quartz vein, which was found to contain a little tungsten and copper. This vein outcrops immediately above

the sheared zone at elevation 6,000 feet, and is followed up and over the shoulder of the mountain at elevation 6,250 feet, from where it extends down into the valley of a small stream that lies half a mile north of Balsam Creek.

The claims blanket a small diorite stock of irregular shape that intrudes greywacke, argillite, and quartzite. The shear zones occur in the diorite or along faults bordering large blocks of the sediments that lie within the stock. In the vicinity of the workings the diorite gives place to sedimentary rocks below an elevation of 5,400 feet. The No. 1 cross-cut adit, driven 430 feet north at elevation 5,150 feet, is entirely in the sediments. They are poorly bedded in the adit, but in general strike east and dip 10 degrees south.

The sheared zone on which most of the early work was done outcrops at intervals up a steep ravine (slope of 34 degrees) between elevations of 5,425 and 5,825 feet. It strikes from north 30 to north 45 degrees west and dips 45 degrees southwest. In the No. 3 adit, at elevation 5,450 feet, the sheared zone ranges from 1 to 4 feet in width. It consists of soft, rusty, pulverized rock largely leached of its sulphide content. An 18-inch channel sample taken across this material, 65 feet from the face of the adit, assayed: gold, 0·015 ounce a ton; silver, 0·09 ounce a ton; tungsten, none. In the No. 4 adit at elevation 5,690 feet the sheared zone is also composed largely of soft, ground-up, rusty, altered rock and has an average width of 3 feet. For 70 feet from the portal the sheared zone is in sediments, but from 70 feet to the face of the drift the hanging-wall is diorite. Along the part of the drift in the sediments the sheared zone is replaced by considerable vein quartz that carries a little pyrite. A channel sample taken across the vein 50 feet from the portal, where there is a 24-inch width of vein quartz containing 3 per cent of pyrite, assayed: gold, 0·54 ounce a ton; silver, 0·79 ounce a ton; tungsten, none.

No. 2 adit is 100 feet southeast of and 35 feet below the No. 3 adit. It is driven 50 feet along a vein that lies parallel to the main sheared zone. This vein ranges from 6 to 24 inches in width, and has been traced less than 100 feet. The hanging-wall is diorite and the foot-wall is altered argillite. The vein consists of the following gangue minerals, in order of abundance, hornblende, quartz, and biotite, and carries a little pyrrhotite, arsenopyrite, and chalcopyrite.

Two parallel sheared zones 15 feet apart outcrop directly above No. 4 adit between elevations of 5,800 and 6,000 feet. Both range from 1 to 4 feet in width. They consist of sheared, rusty, altered diorite with a small sulphide content. At elevation 6,000 feet the upper, sheared zone gives place to a strong quartz vein that increases from 1 to 10 feet in width within 50 feet up the slope. The quartz vein continues up the slope to the top of the ridge, then runs along the shoulder of the mountain at elevation 6,250 feet for about 300 feet before dropping down into the valley on the north. The vein strikes north 45 degrees west and dips from 40 to 75 degrees southwest. It is well exposed between elevations of 6,000 and 6,100 feet, where it has an average width of 7 feet but is only sparsely mineralized with pyrite. In a cut at elevation 6,225 feet the vein is 18 inches wide and the quartz carries possibly 5 per cent of wolframite and a little chalcopyrite. For 300 feet along the top of the ridge

the vein is entirely in the diorite and is covered by talus in most places. The vein outcrops for about 100 feet as it starts down into the valley on the northwest slope of the mountain. There it ranges from 5 to 12 feet in width and carries from 1 to 10 per cent of wolframite with a little chalcopyrite. A representative sample collected from a small cut where the vein is 12 feet wide assayed: gold, a trace; silver, 0·05 ounce a ton; tungsten, 7·03 per cent.

The wolframite is present as small, jet-black crystals, some of which are as much as 1 inch in length. The vein quartz is coarsely crystalline, with some well-formed quartz crystals up to 2 inches in length, and there are occasional vugs and small open spaces. Both quartz and wolframite are accompanied by a little sericite.

During the 1939 season, Consolidated Mining and Smelting Company held an option on this property and stripping and sampling operations were commenced under the direction of A. W. Davis.

Brunswick Group (35)

References: Ann. Repts., Minister of Mines, B.C.: 1914, p. 191; 1925, p. 134; 1926, p. 126.

The Brunswick group, consisting of the Kaslo and Brunswick claims, is on Rocher Déboulé Mountain 8 miles south of New Hazelton. The claims are on the north side of the valley at the head of Balsam Creek, immediately below the Red Rose property. A good pack-trail along the north side of Balsam Creek connects the claims with the Rocher Déboulé mine road. The late owner, Joe Miller of South Hazelton, carried out development work on these claims each year beginning in 1912.

The claims are underlain by poorly bedded sedimentary rocks intruded by small dykes and stocks of diorite and granodiorite. The sediments are largely argillites and greywacke. Along the creek on the Brunswick claim the sediments strike northeast and dip 45 degrees southeast.

A quartz vein occurs in a fault fissure on the east bank of the stream on the Brunswick claim. It is prospected by two adits, the lower at elevation 4,450 feet and the upper at elevation 4,540 feet, 200 feet farther up the 29-degree slope. The lower adit is 155 feet long and the upper one, now caved at the portal, is said to be 90 feet long. In the lower adit the vein ranges from 1 to 3 feet in width and contains from 1 to 4 per cent sphalerite, galena, and tetrahedrite. The vein strikes north 60 degrees east and dips 55 degrees northwest. A representative sample of the mineralized vein quartz collected from a large heap on the dump assayed: gold, 0·005 ounce a ton; silver, 7·72 ounces a ton; lead, 0·76 per cent; zinc, 0·78 per cent. At the portal of the upper adit is a pile of vein quartz, measuring 20 feet by 15 feet by 3 feet, containing an average of 10 per cent of sphalerite, galena, tetrahedrite, and chalcopyrite. There are also thirty bags of selected ore that consists of about 75 per cent of these sulphides. A representative sample collected from a number of bags of the sacked ore assayed: gold, 0·03 ounce a ton; silver, 110·89 ounces a ton; copper, 1·91 per cent; lead, 17·27 per cent; zinc, 28·40 per cent.

Farther up the hill, on the Kaslo claim, a quartz vein 18 inches wide is exposed in an open-cut 20 feet long with a 15-foot face. An average sample collected from the dump of this cut (Minister of Mines report, 1914) assayed: gold, 0·02 ounce a ton; silver, 18 ounces a ton; lead, 8 per cent; zinc 4·6 per cent.

Sultana Group (36)

References: Ann. Repts., Minister of Mines, B.C.: 1921, p. 100; 1922, p. 99; 1923, p. 107. Geol. Surv., Canada, Sum. Rept. 1910, p. 97.

This property is on the south side of the basin at the head of the south fork of Boulder Creek, 8 miles due west of Seaton railway station. The claims are 10 miles distant from the main highway by way of the pack-trail that follows along the south side of Boulder Creek. Brewer Brothers were the first to discover silver and copper minerals in a sheared zone on this property and staked the Last Chance and Little Wonder claims in 1912. A. R. MacDonald and J. S. Hicks, about 1920, restaked the ground with a group of four claims named the Sultana, Sultan, Mugwump, and Delores claims. The sheared zone was prospected by several open-cuts, and in 1923 Granby Consolidated Mining, Smelting, and Power Company put down a single diamond drill hole about 80 feet. The present owner, G. Christiensen of New Hazelton, carried out some surface work in 1939.

A mineralized sheared zone is exposed on a bench at elevation 5,200 feet in the coarsely crystalline grey granodiorite that forms the core of Rocher Déboulé Mountain. The mineralized outcrop is 60 feet long and ranges from 10 to 20 feet in width. It consists of sheared and altered granodiorite replaced by pyrite, tetrahedrite, galena, and chalcopyrite with some quartz gangue. Samples collected by J. D. Galloway (Minister of Mines Report 1922) assayed about 50 ounces of silver a ton with about 5 per cent of copper and a little gold. The zone strikes north 70 degrees east and much of the slicing within it dips 45 degrees southeast. In the open-cut at the northeast end of the outcrop the dip of the slicing changes from 45 degrees southeast on the northwest side of the zone to 80 degrees northwest on its southeast side. It appears that the major fissuring was about vertical along the southeast border of the zone and that the slicing that dips southeast merges with it there. The drill hole put down in 1923 is located 40 feet southeast of the mineralized zone, at a point opposite the centre of the outcrop. It was not ascertained whether the hole was bored vertically or inclined, as it is concealed by boulders. The bore-hole would probably have missed the mineralized zone unless inclined towards it.

Brian Boru Group (37)

References: Ann. Repts., Minister of Mines, B.C.: 1914, p. 191; 1926, p. 127. Geol. Surv., Canada, Mem. 110, 1919, p. 19.

The Brian Boru group is 7 miles southeast of Skeena Crossing at the head of Brian Boru Creek, north-flowing tributary of Juniper Creek. The claims are reached by following the Skeena Crossing-Rocher Déboulé mine road for 5 miles to where a pack-trail, 4 miles long, follows Brian Boru

Creek to a cabin on the south fork of the creek at elevation 4,000 feet. The workings are on the southwest side of a spur that separates the south and east forks of the creek, half a mile southeast of the cabin. The claims are owned by J. Creagh.

At elevation 5,175 feet a 15-foot adit is driven northeast along an aplite sill, 3 feet in width, that intrudes interbedded sandstones and argillites. The sediments and sill strike north and dip 35 degrees east. The sediments are rust stained at their contacts with the sill, but contain only small amounts of disseminated pyrite.

A sulphide vein outcrops 200 feet farther east at elevation 5,280 feet. The vein is 60 feet long and ranges from 3 to 12 inches in width. It consists largely of solid black sphalerite with some pyrite. The vein strikes northeast and dips 45 degrees northwest. It lies in bedded greywacke, which strikes north 30 degrees west and dips 15 degrees northeast. An 8-inch channel sample taken across a particularly rich section of the vein in a small open-cut assayed: gold, 0·015 ounce a ton; silver, 1·36 ounces a ton; zinc, 41·95 per cent.

Another sphalerite vein of similar appearance occurs 150 feet farther east and 60 feet farther up the slope. This vein, prospected by one open-cut, is 35 feet long and ranges from 3 to 12 inches in width. It strikes north 80 degrees east and dips 50 degrees north. At the open-cut near the centre of the vein, the rock on the north side is slightly sheared over a width of 6 feet and is traversed by small seams of pyrite.

In an open-cut 200 feet farther east, at elevation 5,440 feet, there is a sheared zone 6 feet wide that contains numerous stringers of black sphalerite, one of which attains a width of 4 inches. The shearing is very weak and the sulphide stringers pinch out a short distance on either side of the open-cut. A similar sheared zone containing scattered sphalerite stringers over a width of 10 feet, occurs 50 feet below and 75 feet farther along the slope. These sphalerite stringers pinch out 10 feet either side of an open-cut that exposes the greatest width of mineralization.

Roughly 800 feet farther east along the southeast side of the spur, a relatively strong vein occurs in volcanic rocks. This vein has been traced by four open-cuts for 300 feet up the steep slope between elevations of 5,475 and 5,700 feet. The vein strikes northeast and dips 65 degrees northwest. It consists largely of black sphalerite with a little galena, pyrrhotite, and chalcopyrite. In general the vein ranges from 3 to 12 inches in width, but in several places the fissure is tight, with no vein filling. A 6-inch channel sample taken across the vein in the second open-cut, at elevation 5,575 feet, assayed: gold, a trace; silver, 6·43 ounces a ton; lead, 1·84 per cent; zinc, 11·27 per cent.

On the valley floor, at elevation 5,200 feet, below the last-described workings, a number of small veins have been prospected by open-cuts. The veins lie along small fissures of varying strike and dip in volcanic rocks. They are composed largely of sphalerite with considerable pyrrhotite and some pyrite. Most of them are less than 50 feet in length and are too narrow to be of economic value.

Killarney Claim (38)

Reference: Ann. Rept., Minister of Mines, B.C., 1926, p. 128.

The Killarney claim is on the west side of Brian Boru Basin at the head of the south fork of Brian Boru Creek, 7 miles southeast of Skeena Crossing. It is reached by a pack-trail 4 miles in length, which branches from the Rocher Déboulé mine road 5 miles east of Skeena Crossing and leads south to the camp at elevation 4,000 feet on Brian Boru Creek.

About 500 feet south of the cabin, the bed of Brian Boru Creek is formed of fragments of altered rock heavily replaced by pyrite with a little pyrrhotite, sphalerite, and galena. The immediate banks of the creek are muskeg covered, but several hundred feet farther west the mountain rises steeply and there in an open-cut at elevation 4,200 feet there is a heavily pyritized, sheared zone 10 feet in width. The mineralized zone appears to strike up the slope, but has not been found there due to drift cover.

At elevation 4,250 feet, about 200 feet south of the open-cut, an adit, now caved at the portal, was driven along an aplite dyke that intrudes tuffaceous rocks. The dyke is largely concealed by the drift, but its width exceeds 10 feet. The aplite is considerably altered, with a strong development of carbonate, and is impregnated with considerable pyrite and a little galena and sphalerite. The ground is heavily drift covered in the vicinity, but 50 feet farther up the slope the mineralized dyke is exposed in an open-cut. A representative sample of the broken, mineralized rock taken from the dump at this cut assayed: gold, a trace; silver, 1·10 ounces a ton; lead, 0·71 per cent; zinc, 2·19 per cent.

Evelyn Group (41)

References: Ann. Repts., Minister of Mines, B.C.: 1923, p. 110; 1925, p. 136.

The Evelyn group, owned by Angus McLean of Smithers, is on the northeast slope of the northern segment of Hudson Bay Mountain, about 3 miles due southwest of Evelyn station. The property is reached from the station by a good trail about 4 miles long.

A mineralized, sheared zone in andesite has been traced by a dozen open-cuts for 1,000 feet in a horizontal direction and 385 feet in a vertical direction up a 27-degree slope between elevations of 5,150 and 5,535 feet. The sheared zone strikes south 55 degrees west and dips about 45 degrees southeast. It is mineralized with variable amounts of arsenopyrite, pyrite, galena, sphalerite, and tetrahedrite. A boss of granodiorite that lies to the southeast, approaches within 600 feet of the vein.

The most extensive shearing and vein formation were seen in two large open-cuts 45 feet apart at elevation 5,250 feet. In the west cut, the andesite is sheared, altered, and silicified over a width of 7 feet. The altered rock is replaced by finely disseminated pyrite and arsenopyrite, and is traversed by fine veinlets of galena and sphalerite. A chipped sample taken across 7 feet of the altered and mineralized rock assayed:

gold, a trace; silver, 0·91 ounce a ton; lead, 0·29 per cent. In the cut 45 feet farther east there are two parallel sheared zones 6 feet apart that strike south 60 degrees west and dip 40 degrees southeast. The upper zone ranges from 6 to 12 inches in width and the lower from 12 to 16 inches in width. The zones consist of silicified, sheared andesite that contains up to 10 per cent of arsenopyrite with small amounts of galena, sphalerite, and tetrahedrite. A 15-inch channel sample taken across the lower zone in the floor of the cut assayed: gold, 0·0075 ounce a ton; silver, 10·70 ounces a ton; lead, 0·42 per cent.

In an open-cut 160 feet farther down the slope there is a sheared zone 15 feet wide that is mineralized throughout with a little arsenopyrite, galena, and sphalerite. In the lowest cut 50 feet farther down the slope, the sheared zone is 12 feet wide and is only sparsely mineralized with arsenopyrite.

In the west end of a 47-foot crosscut trench, 100 feet up the slope from the first described open-cut, there is a 12-inch zone containing up to 10 per cent of sulphides, most of which is arsenopyrite. Several, small, sparsely mineralized, sheared zones are exposed in the east end of the trench. The zone is also located by an open-cut 70 feet farther up the hill, but this cut was caved at the time of our visit. The zone is not exposed for 500 feet up the slope, but is seen on the shoulder of a ridge at 5,535 feet elevation. From the shoulder of the ridge it continues for several hundred feet along the precipitous east wall of a deep glacial cirque. Where examined on the shoulder of the ridge, it ranges from 4 to 12 inches in width and consists of silicified andesite carrying up to 10 per cent of arsenopyrite with a little galena and sphalerite. A 12-inch channel sample taken across this zone in a small cut on the south side of the ridge assayed: gold, 0·005 ounce a ton; silver, 1·08 ounces a ton.

Carroll Property (42)

References: Ann. Repts., Minister of Mines, B.C.: 1917, p. 114; 1927, p. 136; 1928, p. 163.

The Carroll property is on the south slope of Mount Evelyn, on the north side of Toboggan Creek, 7 miles due northwest of Smithers. A branch trail leaves the main Toboggan Creek trail at elevation 3,900 feet and leads northeast along the slope to the camp at elevation 4,200 feet.

The claims are underlain by andesitic volcanic rocks intruded by granodiorite stocks and aplitic dykes. Several hundred feet below the camp the volcanic rocks are in contact with the older sedimentary rocks that occupy the lower slopes of the valley of Toboggan Creek.

In 1917, Mr. Jobe prospected two galena veins at elevations of 4,600 and 5,200 feet by two adits 100 feet and 90 feet in length, respectively. The veins in both adits are greatly leached, but selected samples showed that they were composed of argentiferous galena with a low gold content. Both veins are short and discontinuous.

During 1928, Mount Evelyn Mines, Limited, drove a 210-foot crosscut adit into the mountain in andesite at elevation 4,100 feet. At 108 feet from the portal a drift was run 55 feet northeast along a sheared, altered, and silicified alaskite dyke. The dyke strikes north 50 degrees east and

dips 65 degrees southeast. It maintains an average width of 18 inches. The altered dyke rock contains finely disseminated pyrite. A selected sample of the altered dyke rock collected from the dump assayed: gold, a trace; silver, 1·26 ounces a ton. This dyke outcrops for a short distance on a steep slope about 125 feet vertically above the adit, where it is prospected by a 10-foot shaft.

Rio Grande Group (43)

References: Ann. Rept., Minister of Mines, B.C., 1934, p. C8. Geol. Surv., Canada, Paper 36-20, 1936, p. 103.

The Rio Grande group is on the south slope of Mount Evelyn on the north side of Toboggan Creek, 8 miles in a straight line northwest of Smithers. The property consists of eight Crown granted claims, the Rio Grande, Spondulix, Rico Aspen, Little Joe, Iron Dollar, Last Hope, Jumbo, and Big Hope Fraction. The lower workings are a few hundred feet from the Toboggan Creek trail.

During 1913, J. Sheedy and J. Fisher, original owners, shipped 2 tons of ore from the property to Granby smelter, which assayed: gold, $2.50 a ton; silver, 84·5 ounces a ton; copper, 7 per cent. A. C. Gardé secured an option on the claims in 1933, and the following year Rio Grande Syndicate was formed to develop the property. A camp was built at elevation 4,500 feet, a short adit was driven, and a little diamond drilling was done by Boyle Brothers. The claims now belong to the Fisher estate and to David Bird.

The claims blanket the south slope of Mount Evelyn from an elevation of 4,000 feet at Toboggan Creek up to the peak of the mountain at elevation 6,600 feet. The lower part of the valley is occupied by rusty weathering shales, sandstones, greywacke, and conglomerate beds with a few thin seams of coal. At elevation 4,700 feet the sedimentary rocks are in contact with volcanic rocks that extend up the slope to the peak. At the contact the sediments strike a little south of east and dip 40 degrees north, so that they underlie the volcanic rocks. The volcanic rocks are intruded by two granodiorite stocks. One of these forms the core of the highest peak of Mount Evelyn and the other extends down the slope for over 1,000 feet from the saddle east of the peak. The latter stock extends easterly for 1 mile down the east shoulder of the mountain.

At elevation 4,600 feet an adit is driven north in the sedimentary rocks to their contact with the volcanic rocks and a short drift runs easterly along the contact. A 3-foot depth of water backed up by a cave-in at the portal prevented examination of this adit during the 1938 season. On the dump there is a small amount of black shale traversed by fine pyrite seams. In an open-cut on the contact of the sediments with andesitic rocks 75 feet above the adit, there is much rusty oxidized rock impregnated with arsenopyrite and pyrite. Similar mineralization was noted in other cuts farther east along the contact. The cuts are largely caved, but mineralization was seen to extend over a width of at least 2 feet.

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At elevation 5,150 feet, two narrow fissures in granodiorite are prospected by a short adit and two open-cuts. The fissures carry up to 2 inches of rusty cellular gouge, but contain no sulphides. A sheared zone 1 foot wide occurs in the granodiorite several hundred feet farther up the slope. In an open-cut at elevation 5,500 feet this sheared zone is rust stained and holds much chlorite, but is otherwise barren. Both the fissures and sheared zone strike north 30 degrees west and dip from 55 to 75 degrees southwest.

A narrow, mineralized zone has been followed down the southeast side of the peak of Mount Evelyn between elevations of 6,600 feet and 6,475 feet by a short adit and several open-cuts. The zone occurs in fine-grained granodiorite along a fault that strikes north 10 degrees west and dips 60 degrees southwest. It is narrow, seldom exceeding 2 inches in width, and in places pinches to a fraction of an inch. It consists of altered rock replaced by considerable tetrahedrite. This is evidently the occurrence from which 2 tons of ore was shipped in 1913.

Last Chance Claim (44)

References: Ann. Repts., Minister of Mines, B.C.: 1918, p. 118; 1926, p. 131.

The Last Chance claim is on the north side of the pass at the head of Toboggan Creek, 8 miles northwest of Smithers. The workings are at an elevation of 5,150 feet, a few hundred feet above the tractor road to the Silver Creek group. The property was held for several years by O. Hanson and J. Sealey.

Several, small, irregular sulphide veins in andesite have been prospected by open-cuts and a short adit. The veins are composed largely of magnetite, with considerable pyrite and a little chalcopyrite.

Three of the sulphide veins are exposed in a shallow open-cut 60 feet long. They occupy fractures that strike from north 55 to north 70 degrees west and dip steeply north. One vein at the east end of the cut is 20 feet long and ranges from 1 to 12 inches in width. Near the west end of the cut, two veins lie parallel, one 20 feet long with an average width of 6 inches, the other 6 feet long and 3 inches wide. All three veins terminate against small cross faults. The andesite wall-rock is somewhat altered, but is only sparsely mineralized.

About 100 feet farther west another vein outcrop is opened up by a small open-cut. This vein is 30 feet long and ranges from 3 to 12 inches in width. It strikes north 55 degrees west and dips 85 degrees northeast. The vein consists of massive magnetite and pyrite cut by small chalcopyrite stringers. A selected sample of this vein, collected by D. Lay in 1926, assayed: gold, a trace; silver, 2 ounces a ton; copper, 2·5 per cent. At the foot of a bluff 20 feet below the vein outcrop, an adit driven 75 feet along a bearing of north 20 degrees east fails to disclose any mineralization of importance. A representative sample of a small amount of vein material collected from the dump assayed: gold, 0·02 ounce a ton; silver, 0·09 ounce a ton; copper, 3·75 per cent; zinc, 0·16 per cent.

Mammoth Claim (45)

The Mammoth claim is on the divide between Toboggan Creek and Silver Lake, at an elevation of 5,000 feet. It is on the south side of the new trail to the Silver Creek group above Schufer's camp.

A vein has been traced in volcanic rocks for 300 feet by four open-cuts. The vein strikes west and dips steeply south. At the most easterly cut the vein averages a foot in width and consists of pyrrhotite, arsenopyrite, and sphalerite, with a little galena. In the more westerly cuts the vein narrows to 4 inches and consists largely of quartz with considerable pyrite and a little chalcopyrite.

Silver Creek Group (46)

References: Ann. Repts., Minister of Mines, B.C.: 1908, p. 64; 1913, p. 108; 1916, p. 123; 1917, p. 114; 1918, p. 118; 1919, p. 103; 1920, p. 90; 1926, p. 129; 1927, p. 137; 1935, p. C39. Geol. Surv., Canada, Sum. Rept. 1925, pt. A, p. 139.

The Silver Creek group (*See* Figure 8), owned by Peter Schufer of Smithers, B.C., is on the northwest slope of Hudson Bay Mountain 8 miles due northwest of Smithers. There are six claims in the group, Copper Queen, Iron Mask, Texado, Lily Fraction, Iron Vault, and Van Anda. The property is reached from Smithers by motor road and a 4-mile long tractor road that was improved during the 1938 season by the Department of Public Works. The tractor road extends from elevation 2,400 feet at Toboggan Creek to the mine workings at elevation 5,500 feet. The mine camp is at elevation 4,700 feet, at the head of Toboggan Creek.

The property was staked in 1908 by P. Schufer and L. Woods, following the discovery of pyrrhotite-sphalerite ore. Hudson Bay Mining Company bonded the group in 1910 and carried on development work until 1914. In 1917 the owners shipped 9,205 pounds of ore from a newly discovered deposit to the Trail smelter, which assayed: gold, 0·26 ounce a ton; silver, 246·1 ounces a ton; lead, 41·8 per cent; zinc, 18·8 per cent. The following year, a 30-ton carload of similar ore shipped to the Silver Standard mill for concentration averaged $175 a ton gross in all values. British Canadian Silver Corporation, Limited, explored the silver-lead occurrence in 1926 with a 200-foot drift; W. R. Wilson and Sons carried out further work during 1935 and 1936.

On the Iron Vault claim, dark green and purple andesites with some interbedded tuffs are separated from a series of greenish tuffs by a band of fossiliferous limestone. The green tuffs pass upwards to the south into a thick formation of purple tuffs. The tuffs are mostly fine grained and massive, but some beds are well laminated. These bedded rocks strike easterly and dip from vertical to 50 degrees north. The top of the series is believed to be to the south, so that where the dip is to the north or northeast the strata are overturned. These rocks are intruded by a stock of granodiorite outcropping at the south end of the Iron Mask claim and extending westerly across the Copper Queen and Lily Fraction claims. The stock ranges from 400 to 1,000 feet in width and approaches 3,000 feet in length. The granodiorite is cut by a lamprophyre dyke 30 feet wide and dipping at a low angle to the south.

The limestone band is cut off on the west by the granodiorite stock. It is followed by natural exposures and a series of cross trenches for 1,450 feet in an east to southeast direction to where it ends along a fissured zone near the top of a steep bluff at elevation 5,475 feet. The limestone formation is lenticular in outline, attaining a maximum width of 65 feet midway along its outcrop. Lens-shaped ore-bodies consisting of a pyrrhotite-sphalerite-pyrite replacement of limestone occur at intervals along the limestone horizon. The mineralization appears to be localized to zones where small faults pass into the limestone. Recrystallization and flowage have absorbed differential movement within the limestone, so that fissures do not penetrate this formation beyond a few feet. Consequently, the ore-bodies are commonly along the contact of the limestone. The ore-bodies are short and lenticular in surface outline, but may be pipe-shaped.

About 150 feet south of the easterly end of the main limestone band there is a smaller body of limestone lying on the south side of a fault. This mass is 60 feet wide where it borders the fault, but narrows and ends 300 feet to the southeast. Midway along its strike it splits and the southeast branch, ranging from 4 to 10 feet wide, runs down the north wall of a small, steep ravine for about 150 feet. This limestone body is believed to have formerly been an upward extension of the main limestone horizon, and to have been downfaulted to its present position. At the contact of the limestone with the fault there is a replacement ore-body that resembles the pyrrhotite-sphalerite-pyrite type, but here the replacement minerals include galena, arsenopyrite, and chalcopyrite. Northeast of the limestone, where the wall-rocks along the fault are andesitic flows and interbedded tuffs, there is a calcite vein containing silver, lead, and zinc sulphides.

About 275 feet from the east end of the main limestone band there is an outcrop of solid sulphides along the south side of the limestone at its contact with green tuffs. The sulphide body is lenticular, 50 feet long, and with a maximum width of 15 feet. It consists of solid sulphides, there being about 40 per cent black sphalerite, 40 per cent pyrrhotite, and 10 per cent pyrite. A shallow shaft is sunk at the centre of the ore-body and about 20 tons of ore from the shaft is stockpiled. A grab sample of this ore assayed: gold, 0·165 ounce a ton; silver, 1·30 ounces a ton; zinc, 17·43 per cent; nickel, none.

At distances of 30, 45, and 60 feet, respectively, east of the 50-foot sulphide lens trenches cut across the limestone disclose a heavily rusted, oxidized zone 10 feet wide. About 140 feet farther east, near the east end of the limestone band, there is an oxidized zone 12 feet wide exposed in an open-cut near the top of a steep bluff. The oxidized zone grades downward within a few feet to unmineralized limestone. It evidently is merely fragments of rocks cemented by limonite derived from oxidation of a nearby sulphide lens. A little farther down the steep slope the limestone pinches out abruptly, and from its tip a sheared zone continues down the slope. The sheared zone strikes east and dips 70 degrees north. At elevation 5,375 feet an adit is driven 125 feet along this sheared zone in andestic rocks, but does not disclose any mineralization. The face of the adit is roughly 125 feet below the east tip of the main limestone

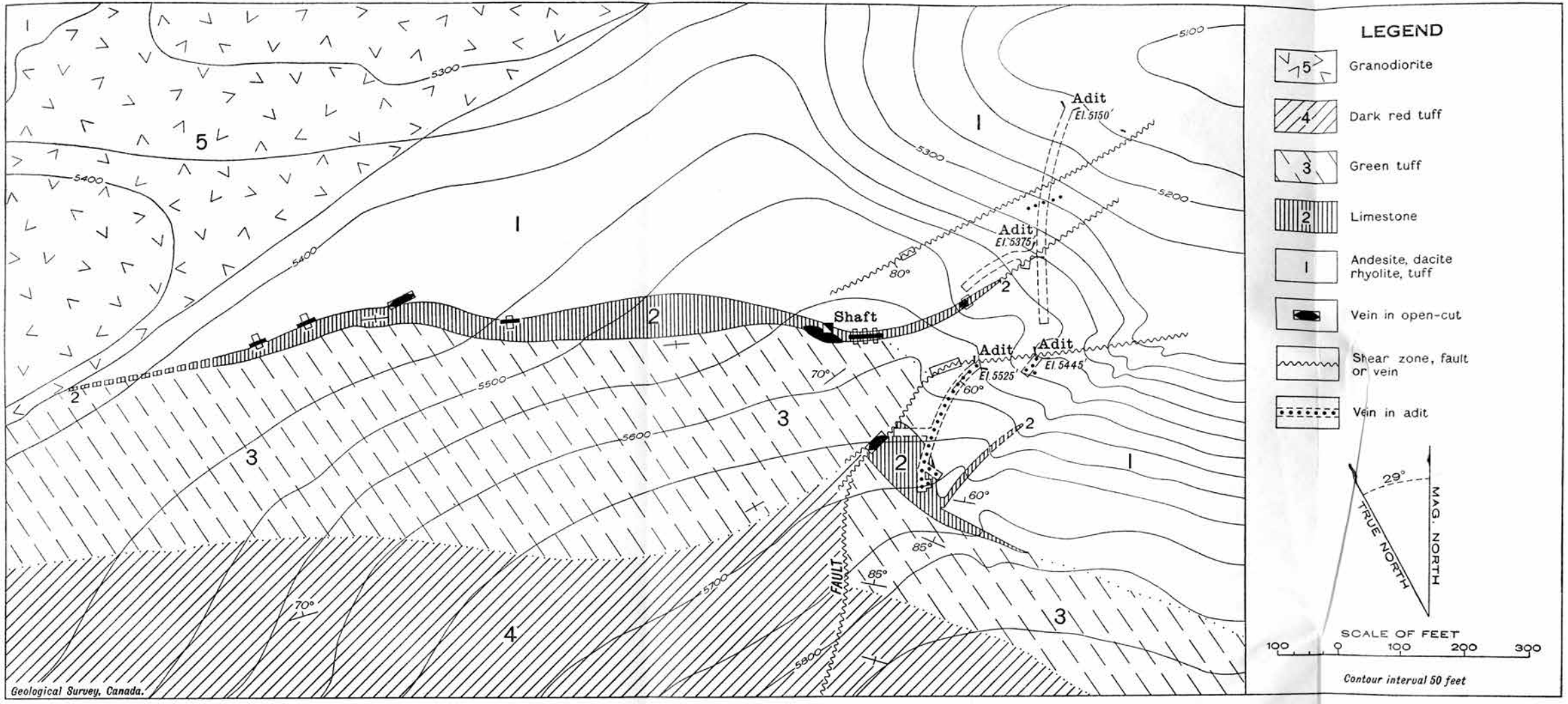

Figure 8. Plan of part of Silver Creek group.

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Geological Survey Canada.

horizon. If this adit is driven farther west it will doubtless enter the downward projection of the limestone band along which the sulphide lenses are found.

Other sulphide lenses are exposed in open-cuts along the north side of the limestone band at distances of 500, 650, 800, and 900 feet, respectively, west of the shaft. These occur along the north border of the limestone along small faults, both as fissure fillings and as replacements of the wall-rocks. The mineralization in the cut 500 feet west of the shaft is a replacement of the limestone. The mineralized rock is of irregular outline, averages 2 feet in width, and is exposed for about 30 feet. In the cut 150 feet farther west there is a sulphide lens about 25 feet in length that has a maximum width of 7 feet. It consists largely of sphalerite and pyrite with minor amounts of pyrrhotite. A representative sample of the ore from this cut assayed: gold, 0·075 ounce a ton; silver, 1·45 ounces a ton; zinc, 12·94 per cent. The two most westerly pits are 90 feet apart and are sunk on the same body. It ranges from 2 to 5 feet in width in these cuts and is well mineralized with pyrrhotite, sphalerite, and pyrite. It is a replacement of calcareous argillite along a sheared zone lying 6 feet south of fossiliferous limestone.

At 100 feet north of the east end of the main limestone horizon, a 20-foot long trench is sunk on a sheared zone 2 feet wide in andesite. The sheared rock in the cut is lightly rust stained and is sparsely mineralized. The shear zone strikes east and dips 70 to 80 degrees south. West of the open-cut it runs into the limestone bed where its identity is lost. No mineralization was noted at the contact of this fissure with the limestone. East of the open-cut the sheared zone is exposed for 400 feet in a horizontal direction and 375 feet in a vertical direction down the face of a steep bluff. Where examined at the foot of the bluff, the shear zone is 6 inches wide and is replaced by a little pyrite. From a convenient point at elevation 5,150 feet, and 120 feet north of the vein outcrop at the foot of the bluff, a crosscut adit was driven 25 years ago to intersect the shear zone and explore the ground farther south. The adit is driven 345 feet in a southwest direction and the shear zone is intersected 150 feet from the portal. Here the shear zone is less than a foot wide and contains a sphalerite vein with a little pyrite ranging from 2 to 6 inches in width.

A calcite vein occurs along a fault in andesitic rocks between 70 and 150 feet south of the east end of the main limestone band. The vein consists of brecciated and sheared andesite cemented by calcite with variable amounts of galena, sphalerite, tetrahedrite, arsenopyrite, and pyrite. It ranges from 6 to 18 inches in width and has been traced for 350 feet in a horizontal direction and 225 feet in a vertical direction by two adits and by open-cuts. Below an elevation of 5,425 feet the vein is covered by a steep talus slide. The fault in which the vein occurs has a marked vertical displacement. The fault has a curving strike, changing from south 80 degrees west to south 30 degrees west, and dips from 55 to 65 degrees southeast. At elevation 5,650 feet the fault is bordered on the south by a body of limestone 50 feet in width. The limestone has been heavily replaced along the fault by massive sulphides to form a body of lenticular outline measuring 30 feet long and 15 feet wide. The sulphides are present in the following order of abundance: pyrite, sphalerite, galena,

arsenopyrite, pyrrhotite, and chalcopyrite. Southwest of the limestone body the fault is somewhat split up, but none of the branches contains any vein filling nor shows evidence of mineralization. At elevation 5,525 feet, an adit drift follows the calcite vein for 235 feet in a southwest direction. The limestone body is encountered 200 feet from the portal and continues along the south side of the vein fissure for 30 feet. The limestone is replaced by sulphides along the fault as at the surface 125 feet above. The percentage of sulphides present varies considerably from place to place, ranging from 3 or 4 per cent up to 95 per cent of the mass. In general sphalerite is the predominant mineral, and is accompanied by small amounts of galena, arsenopyrite, pyrite, pyrrhotite, and chalcopyrite. The heaviest mineralization occurs east from the fault, along the east edge of the limestone body. A 20-foot crosscut driven southeast along this contact, with a 10-foot winze sunk from the end of it, discloses continuous mineralization with several irregular-shaped replacements of almost solid sulphides. A representative sample of the ore, containing about 10 per cent of sulphides, collected at the intersection of the drift and the 20-foot crosscut, assayed: gold, 0·01 ounce a ton; silver, 6·29 ounces a ton; lead, 2·04 per cent; zinc, 3·50 per cent.

Along the main drift the fissure vein ranges from 4 inches to 3 feet in width and shows wide variation in its mineral content. Near the portal it is 3 feet wide, consisting of brecciated andesite cemented by calcite, but containing no sulphides. At 25 feet from the portal it is mineralized with arsenopyrite over a width of 11 inches. At 40 feet from the portal the vein consists of 4 inches of solid sulphides, largely sphalerite with some galena, arsenopyrite, and tetrahedrite. From there to the limestone replacement ore-body the vein ranges up to 3 feet in width, but in most places contains only small veinlets and replacements of sulphides. West of the limestone the vein pinches, and it is barren at the face of the drift.

At elevation 5,445 feet an adit is driven 46 feet along the silver-lead vein. For 20 feet from the portal the vein ranges from 6 to 12 inches in width. It consists of brecciated andesite cemented by calcite and contains about 3 per cent of galena with a little pyrite and arsenopyrite. Beyond 20 feet the vein splits and the adit follows the smaller of the two branches. This branch narrows to 3 inches towards the face and is only sparsely mineralized. The vein is exposed for about 25 feet below the adit down the face of a steep bluff and then disappears under a long talus slide. Immediately above the talus, the vein consists of 6 inches of sheared andesite replaced by about 5 per cent of arsenopyrite. A 6-inch channel sample of this material assayed: gold, 0·12 ounce a ton; silver, 36·89 ounces a ton.

On the southeast part of the Copper Queen claim there is a mineralized sheared zone in the granodiorite stock. The vein strikes north 80 degrees east and dips 83 degrees north. It ranges from 2 to 4 feet in width and can be seen to continue along the surface for about 200 feet. The sheared and altered rock is traversed by small sulphide stringers and seams consisting of pyrite, arsenopyrite, and pyrrhotite. A 12-inch channel sample taken across the central part of the vein at the portal of the adit assayed: gold, 0·15 ounce a ton; silver, 2·86 ounces a ton.

A fault lies along the north side of the granodiorite stock at its contact with volcanic rocks, which outcrop on the north side of the pass. The fault strikes east and dips 70 degrees south. It is best exposed in an open-cut at elevation 5,000 feet, where there is 3 feet of sheared, rusted, altered rock. Elswhere the fault is concealed by drift.

Josie Claim (47)

The Josie claim is on the east shoulder of a cirque immediately east of the Van Anda claim of the Silver Creek group. A trail leads up to the workings from the lowest crosscut adit on the Silver Creek group.

At elevation 5,300 feet two parallel sulphide veins in andesite are prospected by an open-cut and a 6-foot adit. The veins are 20 inches apart and range from 1 to 8 inches in width. They are composed of sphalerite, pyrrhotite, and pyrite. The veins strike north 70 degrees east and dip 57 degrees southeast. They are covered by talus 10 feet west of the open-cut and pinch out 20 feet east of the cut.

Another sulphide vein outcrops 50 feet higher up the slope in similar andesitic rock. This vein is 50 feet long and averages 6 inches in width, but at the open-cut midway along its outcrop narrow mineralized fissures extend over a maximum width of 3 feet. The vein strikes north 40 degrees east and dips 65 degrees southeast. It consists largely of dark, solid sphalerite with minor pyrrhotite and pyrite.

Matuss Claim (48)

This property, owned by Joe Matuss, of Driftwood, is about 8 miles due northwest of Smithers, on the west side near the foot of the Toboggan Creek glacier. A trail half a mile long leads southeast to the claim from Schufer Lake on the tractor road to the Silver Creek group.

At elevation 4,600 feet an adit has been driven 90 feet along a quartz-arsenopyrite vein that lies in a shear zone in massive andesites. The shear zone is exposed for 500 feet up a 35-degree slope and contains vein filling for most of this distance. The vein strikes southwest and dips from 50 to 70 degrees southeast. About 425 feet north of the adit the volcanic rocks are in sharp contact with shales, argillites, and greywacke. The volcanic rocks are hard, tough, and resistant, whereas the sediments are soft, characteristically rust-stained, and form small slabs as a result of weathering. The upper surface of the andesite beneath the sediments is smooth, but is irregular with depressions up to a foot in depth and anywhere from 5 to 25 feet in diameter. These are filled by fine argillite, which grades up into coarse greywacke composed largely of rounded grains of andesite. The greywacke is succeeded by dark slate. At the contact these formations strike west and dip 70 degrees north. Both the volcanic and sedimentary rocks are intruded by light-coloured quartz-albite porphyry dykes, most of which range from 4 to 10 feet in width and from 500 to 1,000 feet in length. One of these dykes, 7 feet in width, intersects the vein 15 feet from the portal of the adit. The dyke is clearly later than the fissuring.

At the portal of the adit the sheared zone ranges from 3 to 4 feet in width and contains a quartz-arsenopyrite vein 1 foot wide. The vein consists of about 40 per cent quartz and 60 per cent arsenopyrite. Other quartz-arsenopyrite stringers lie in both walls of the sheared zone. The vein narrows gradually within the adit, consisting of 7 inches of almost solid arsenopyrite 20 feet from the portal and 3 inches of arsenopyrite with quartz 35 feet from the portal. Where it narrows to 3 inches another quartz-arsenopyrite vein, 6 inches wide, comes in along the hanging-wall side of the sheared zone. The latter vein maintains an average width of 6 inches for 50 feet to the face of the adit, and for this distance lies along the hanging-wall side of a sheared zone 15 inches wide. A 5-inch channel sample taken across the quartz-arsenopyrite vein 40 feet from the portal assayed: gold 0·36 ounce a ton; silver, 0·05 ounce a ton.

In an open-cut at elevation 4,650 feet, the sheared zone is 4 feet wide with 12 inches on the hanging-wall side replaced by arsenopyrite. At the next open-cut, elevation 4,715 feet, the mineralization has changed. A lens consisting of black sphalerite and pyrrhotite cut by stringers of chalcopyrite occurs along the fissured zone. The lens is 30 feet long, with an average width of 6 inches. The andesite wall-rock is mineralized over a width of several feet on either side of the 30-foot lens by small stringers of similar sulphides. The bedrock is washed clean for 30 feet at elevation 4,800 feet, and there the sheared zone is 8 inches wide. A parallel sheared zone 6 inches wide lies 12 feet to the southeast. Both are well mineralized with arsenopyrite, but are leached and oxidized by surface weathering. In a natural exposure 100 feet farther up the slope there are three parallel sheared zones, 6 and 10 feet apart, respectively. They are each 3 inches in width and contain very little arsenopyrite.

Silver Lake Group (49)

References: Ann. Repts., Minister of Mines, B.C.: 1917, p. 124; 1926, p. 130; 1927, p. 137; 1928, p. 164; 1929, p. 165; 1931, p. 73; 1933, p. 98; 1934, p. C6.

The Silver Lake group, owned by Peter Schufer of Smithers, is 8 miles due northwest of Smithers on the northwest shoulder of Hudson Bay Mountain. There are seven claims in the group, the Silver Lake No. 1, Silver Lake No. 2, Silver Lake No. 3, Bee, Cee, A Fraction, and Second Glacier. The principal mineral occurrences are on a plateau between elevations of 6,500 and 7,000 feet. The claims are due south of the Silver Creek group, from which they are reached by switchback pack-trail. A tractor road 4 miles long connects the latter property with the road to Lake Kathlyn and Smithers near the foot of the mountain.

The property was located under the title of White Heather group by Frank Martin a few years prior to 1916, and a few tons of hand-sorted silver-copper ore were shipped at that time. L. S. McGill and P. Schufer restaked in 1926, and prospected several newly discovered silver-lead veins during the next few years. W. R. Wilson and Sons held an option on the property for several years commencing in 1929, and carried out considerable prospecting work by digging numerous open-cuts through the shallow covering of rock debris and by driving a short adit.

The claims are underlain by red tuffs, red breccias, green tuffs, and andesite flows. A banded limestone bed 6 feet wide is interbedded with the tuffs. These strike southeast and dip steeply north.

At elevation 6,400 feet an adit has been driven 110 feet south 14 degrees east in massive, poorly bedded, red tuffs. The adit follows a tight fault fissure for 50 feet, but discloses no mineralization. The fault strikes south and dips vertically. In a large cut on the surface 40 feet above and 25 feet east of the face of the adit a small, irregular, sheared zone is exposed. It ranges from 1 to 4 inches in width and is traversed by stringers and veinlets of bornite. Its length does not exceed 100 feet. A few tons of ore were shipped from this cut in 1916. A representative sample of the ore collected at that time by Mr. Galloway assayed: gold, 0·45 ounce a ton; silver, 120·1 ounces a ton; copper, 47·8 per cent.

Commencing a few hundred feet farther south, above elevation 6,500 feet, there is a gently rising flat some 3,000 feet in length from east to west and 1,500 feet wide from north to south. A well-built cabin is located on the north rim of the flat at elevation 6,450 feet. Over most of the flat the bedrock is concealed by a shallow covering of disintegrated rock. Several veins have been located south and southeast of the cabin by sinking test pits on the site of disintegrated vein material. In an open-cut some 500 feet south of the cabin, a galena vein occurs along a fault fissure striking south 50 degrees east and dipping 60 degrees northeast. The vein contains up to 5 per cent of chalcopyrite associated with the solid galena. It ranges from 1 to 3 inches in width. Other open-cuts sunk at intervals for over 400 feet along the strike of the vein disclose a persistent fault fissure with a very variable mineral content. In many of the cuts the fault fissure is narrow and contains very little or no vein filling. In a cut at elevation 6,700 feet a vein is exposed for 15 feet. The vein ranges from 3 to 12 inches in width, and consists of solid, coarsely crystalline galena with less than 1 per cent of chalcopyrite. A representative sample taken from a ton of this ore piled beside the cut assayed: gold, 0·10 ounce a ton; silver, 102·55 ounces a ton; lead, 83·58 per cent.

On the north rim of the flat 1,000 feet east of the cabin, a sheared zone in fine-grained andesite is exposed for 300 feet by five open-cuts. It strikes from east to south 60 degrees east and the dip ranges from vertical to 70 degrees south. In the west trench, at elevation 6,600 feet, the sheared zone is barren. In a large cut 50 feet farther east the sheared zone is 6 feet wide and there are three sulphide veins, two of them 12 inches wide and the other 3 inches wide, separated by 3 feet and 1 foot of barren rock, respectively. The vein filling consists of roughly equal parts of solid galena and dark sphalerite with a little chalcopyrite. A representative sample of this ore assayed: gold, 0·24 ounce a ton; silver, 33·51 ounces a ton; lead, 26·21 per cent, zinc, 28·45 per cent; copper, 0·74 per cent. In the next cut, 60 feet farther east, there is a single, sparsely mineralized shear zone. In the fourth cut, 70 feet farther east, there is a sulphide vein, 2 inches wide, composed of sphalerite and galena with a little chalcopyrite. A similar vein ranging from 6 to 8 inches in width is exposed in a fifth open-cut, about 100 feet farther east. Here dark sphalerite is the more abundant mineral and it is accompanied by a little carbonate gangue.

Several other smaller veins are exposed in open-cuts in either andesitic or tuffaceous volcanic rocks near the centre of the flat.

Glacier Gulch North Side Group (50)

References: Ann. Repts., Minister of Mines, B.C.: 1926, p. 131; 1927, p. 137; 1928, p. 163; 1929, p. 164; 1934, p. C5; 1937, p. C21.

This property, owned by S. F. Campbell, Grover Loveless, and Wesley Banta of Smithers, is on the north side of Glacier Gulch on the east side of Hudson Bay Mountain, 5 miles northwest of Smithers. The workings are at an elevation of 2,900 feet about 400 feet above the Glacier Gulch motor road.

Surface work by the owners in 1926 and 1927 disclosed four small veins containing considerable zinc with variable amounts of gold and silver. F. H. Taylor sank a shaft 23 feet on the larger vein in 1928 and found that it contained much less zinc and silver at that depth. During the 1937 season the owners constructed a short tram-line from the shaft to the road and got out a carload of ore.

The veins occur in volcanic rocks close to a fault contact with younger sedimentary rocks that lie to the east. The volcanic rocks are fine-grained, dark andesites. An albite porphyry dyke 12 feet wide intrudes the andesitic rocks, but does not appear to have any connection with the mineralization. The dyke is exposed on the steep face of the gulch (54-degree slope here) about 75 feet west of the shaft. It strikes north 25 degrees west and dips 80 degrees east. A sheared zone follows along or close to the west wall of the dyke, but contains no sulphides. The sedimentary rocks lie 20 feet east of the shaft. Their contact with the volcanic rocks is marked above this point by a narrow, steeply rising gully, but below 2,925 feet the contact is covered by talus. In the gully the contact strikes north and dips from 60 to 70 degrees east. The steeply rising andesite walls on the west side of the gully are slickensided by fault movement. The sediments are rusty weathering quartzite, greywacke, slate, and conglomerate, with a number of coal seams near the base of the formation. Two of these coal seams 50 feet east of the shaft are 12 inches and 8 inches wide and are separated by 16 inches of shale. Two other seams, 1 foot and 2 feet in width, respectively, were noted at points 50 and 100 feet farther east. All of these seams are dirty and none of them has been opened by test pits. In this vicinity the coal-bearing strata strike north and dip from 45 to 60 degrees east.

At the shaft (elevation 2,950 feet) the main vein outcrops along the surface for a distance of 60 feet. It consists largely of dark sphalerite with minor amounts of arsenopyrite, pyrite, pyrrhotite, galena, and chalcopyrite. These sulphides are accompanied by a little quartz gangue. The vein strikes north 10 degrees east and dips from 50 to 60 degrees west. It ranges from 4 inches to 2 feet in width and has an average width of a little under 1 foot. The vein is a fissure filling along a fault of small displacement. The fissuring extends to the fault contact of the volcanic rocks with the sedimentary rocks north of the shaft, but appears to be poorly mineralized near this contact. The shaft is reported to be 23 feet in depth, and at a depth of 12 feet a drift extends 11 feet north of the centre of the shaft. At the bottom of the shaft the vein consists of 9 inches of mineral, almost entirely pyrrhotite. The British Columbia Minister of Mines report for 1937 states that a sample collected by D. Lay

from the bottom of the shaft assayed: gold, 0·06 ounce a ton; silver, 0·6 ounce a ton. Another sample collected by Mr. Lay across 18 inches on the face of the drift assayed: gold, 0·20 ounce a ton; silver, 6·8 ounces a ton; lead, 2 per cent; zinc, 5·4 per cent. An 8-inch channel sample collected by the writer across the vein 6 feet south of the shaft assayed: gold, 0·33 ounce a ton; silver, 2·39 ounces a ton; lead, 1·57 per cent; zinc, 27·56 per cent.

In an open-cut 85 feet south of the shaft there is a sphalerite vein 15 feet long that ranges from 3 to 5 inches in width. Commencing 60 feet farther southwest a vein is exposed for 40 feet in a horizontal direction along the steep slope. This vein has an average width of 1 foot, and consists of about equal parts of vein quartz and pyrrhotite with a little chalcopyrite. An 8-inch channel sample collected across this vein assayed: gold 0·36 ounce a ton; copper, 0·54 per cent; nickel, none.

There is an open-cut on another small vein 75 feet southeast of the shaft. This vein is exposed for 40 feet and ranges from 3 to 12 inches in width. It consists largely of solid sphalerite with 5 to 10 per cent of quartz gangue and a little galena, pyrrhotite, and chalcopyrite.

Glacier Gulch Gold Group (52)

References: Ann. Repts., Minister of Mines, B.C.: 1929, p. 164; 1930, p. 140; 1933, p. 97; 1934, p. C5; 1935, p. C35. Geol. Surv., Canada, Paper 36-20, 1936, p. 93.

The Glacier Gulch Gold property is on the south side of Glacier Gulch 5 miles northwest of Smithers, on the east slope of Hudson Bay Mountain. The claims are owned by Stewart F. Campbell, Grover Loveless, and Wesley Banta of Smithers. The property is 2½ miles west of the Canadian National Railway station at Lake Kathlyn and is reached by way of a good motor road that follows up Glacier Gulch to an elevation of 2,600 feet, directly below the workings. A switchback trail leads up to the workings, which lie between elevations of 3,150 and 3,400 feet, and an aerial tramline connects the mine with the end of the road. A branch trail leads 700 feet easterly from the tram-line to a silver-lead-zinc vein, which outcrops between elevations of 2,800 and 3,300 feet on the same property. The mine camp is in the timber on the banks of Glacier Creek near the end of the road.

Glacier Gulch is a narrow, U-shaped, steep-walled ravine nearly a mile long and trending northeasterly. At the head of the gulch, the ground rises as a precipitous bluff for 1,000 feet to a glacial, ice-filled valley. The melting ice supplies an abundant flow of water throughout most of the year. Rock outcrops are plentiful on both sides of Glacier Gulch, but prospecting is hindered by the steep slopes, which commonly fall away at angles exceeding 40 degrees.

Gold associated with bismuth minerals was discovered on this property by the owners in 1929. Development work during the next few years disclosed a number of small shoots of high-grade gold ore. In 1933 the owners shipped 26 tons of ore that contained 82 ounces of gold and 15 ounces of silver, in addition to bismuth, which was not paid for. R. W. Wilson held an option on the property during 1934 and made another

shipment of ore. The owners resumed work in 1935 and shipped an additional 30 tons of high-grade gold ore. In the autumn of 1937 some ore was shipped from the silver-lead-zinc vein that lies 700 feet east of the gold-bearing veins. Further shipments of the gold-bismuth ore were made during 1938. The initial lot of 350 pounds of dry ore sent to the sampling plant at Prince Rupert assayed: gold, 3·0 ounces a ton; silver, 1·2 ounces a ton.

The gold-bismuth deposits occur along sheared and altered zones in massive, finely crystalline tuffs, with which some beds of argillite are interstratified. Most of the sheared zones lie parallel to bedding planes and appear to have formed as a result of relatively small movements produced when these rocks were folded. These zones have a predominant southeast strike and dip 20 to 40 degrees southwest in the lower, more westerly occurrences. The upper and more easterly zones strike south and dip 20 degrees east. Some of the sheared zones are steeply inclined and connect a number of those with low dips. The productive zones are largely confined to the crest of an anticlinal fold, the axial plane of which is about vertical and which trends in a southwest direction. The fold has a pitch of about 25 degrees to the southwest. A short distance above the deposits the rocks are largely argillites with some interbedded greywacke and conglomerate. These beds strike southwest and dip about 50 degrees southeast. Below the deposits the tuffs pass downwards into a thick series of andesite flows. A silver-lead-zinc vein occurs along a fault fissure in these andesitic rocks about 700 feet northeast of the gold-bismuth deposits. About 400 feet farther northeast the andesites are in faulted contact with younger sediments. These sediments are slate, quartzite, argillite, and conglomerate, and contain numerous narrow coal seams near the base of the formation. No intrusive rocks were seen in the immediate vicinity of the mineral deposits, but boulders of coarse porphyritic granite were noted near the foot of the glacier at the head of Glacier Gulch. The volcanic rocks at the foot of the glacier are intruded by lamprophyre dykes up to 20 feet in width, and joint planes in these dykes contain seams of calcite and molybdenite up to half an inch wide.

The bulk of the ore mined to date has been quarried from a relatively small area, measuring possibly 150 feet in length and rising through a height of 75 feet. The sheared and altered zones commonly exceed 100 feet in length and have an average width of from 1 to 2 feet. There are five or six of these zones roughly parallel to one another in the productive area. The ore shoots range from a few inches up to several feet in width and from a few feet up to 50 feet in length. The ore occurs in the most altered parts of the sheared zones, where the tuff is bleached to a dull white colour. This type of rock grades along the sheared zones into less altered, dull yellowish brown rock. A number of samples of the less altered rock were assayed for gold with negative results. In some cases the altered rock is replaced by considerable quartz. The limited number of samples collected seems to indicate that the vein quartz carries gold in economic amount only where tetradymite is present.

The high-grade ore (*See* Plate III) is a white, silicified tuff holding the bismuth telluride, tetradymite. This mineral occurs as very thin seams along the planes of shearing and as irregular replacements, and is

always accompanied by fine native gold. Some ore contains only 2 or 3 per cent of the tetradymite, but in the richest ore the bismuth mineral constitutes up to 50 per cent of the mass. The tetradymite occurs both as compact, steel-grey crystals ranging from a small fraction of an inch up to 3 inches in length and as a mass of crystals in the altered rock. The platy crystals are commonly dark due to a thin film of iridescent tarnish. The altered rock consists of albite and quartz with calcium carbonate, talc, and sericite. Rock alteration was followed or accompanied in many places by introduction of vein quartz. The quartz is present both as veins along the centre of the sheared zones and as fine veinlets or irregular pockets in the altered rock. In an open-cut above the tramway terminal altered tuff is replaced by coarsely crystalline quartz, from which some excellent specimens of both tetradymite and bismuthinite (bismuth sulphide) were collected. Fine grains of native gold were observed along the platy cleavage in both the tetradymite and bismuthinite. Gold was also seen in the vein quartz and in the altered rock close to small crystals of the bismuth minerals.

The main adit at elevation 3,200 feet is driven south 27 degrees east for 40 feet as a drift. Then it turns at right angles, extending northeast an additional 41 feet. At 12 feet from the face a raise has been driven up 30 feet to the surface along a sheared zone that strikes south 35 degrees east and dips 45 degrees southwest. Considerable ore is reported to have come from the upper part of the raise, where the shearing and alteration widens to 6 feet. Between the raise and the face of the adit there is a small fold in the tuffs, which are partly altered over a width of several feet. An 18-inch channel sample taken across the central part of the altered zone on the face of the adit assayed: gold, none. For 40 feet from the portal the adit follows another altered zone from 1 to 2 feet in width, which strikes south 25 degrees east and dips 20 degrees southwest. Channel samples of the altered rock taken 4 feet from the portal and midway between the drift and raise grave negative assays for gold. In both cases the samples were of light brown, altered, silicified tuff, but contained no tetradymite.

Sixty feet northwest of the main adit and 57 feet lower down the bluff an adit is driven 43 feet along a sheared zone that strikes south 50 degrees east and dips 40 degrees southwest. The sheared zone carries a quartz-calcite vein that ranges from 6 to 12 inches in width, but pinches 4 feet from the face. The tuff on either side of the vein is altered to a yellowish brown colour over a width of 1 foot. The vein does not carry any sulphides or bismuth minerals, and a 9-inch channel sample taken across it 20 feet from the portal assayed: gold, none.

Fifty-five feet northeast of the main adit and 10 feet lower, an adit is driven 27 feet along another sheared and altered zone in tuffs. This zone strikes south 50 degrees east and dips 25 degrees southwest. A 22-inch channel sample taken across it 10 feet from the portal assayed: gold, 0·005 ounce a ton.

From the floor of a quarry 75 feet southeast of the main adit and 40 feet higher, an adit has been driven 28 feet south along the upward continuation of the zone on which the raise was driven. At the portal the zone is 3 feet wide, but it narrows to 10 inches at the face. It strikes

south and dips 20 degrees east. A branch drift runs 33 feet east along this zone from a point 10 feet from the portal. Throughout the adit the sheared rock is replaced by considerable quartz, but contains only 1 to 2 per cent of tetradymite. An 18-inch channel sample taken across the vein 10 feet from the portal assayed: gold, 0·055 ounce a ton.

Four other short adits were driven into the base of the cliff from the floor of the quarry, and all explore similar sheared and altered zones. In some cases they were driven on small pockets of high-grade ore.

During the 1938 season the owners were mining an ore shoot about a foot in width on a narrow ledge about 20 feet above the floor of the quarry. Some of this ore consisted of over 50 per cent of tetradymite and averaged 3 ounces of gold a ton. Considerable, white, altered tuff containing from 1 to 3 per cent of tetradymite is scattered on the floor of the quarry and has evidently been discarded as too low grade to ship. A representative sample of this material collected near the collar of the raise assayed: gold, 0·32 ounce a ton; silver 0·28 ounce a ton; bismuth, 0·05 per cent. Fragments of similar ore of milling grade lie on the talus slide below the workings.

In an open-cut 125 feet northeast of the quarry, there is a sheared and silicified zone 26 inches wide, which strikes north 50 degrees east and dips 30 degrees southeast. A 26-inch channel sample taken across the zone in this cut assayed: gold, 0·02 ounce a ton.

Other sheared and altered zones occur at intervals for over 500 feet southwest of the quarry along the steep slope. Three of these, prospected by small open-cuts, disclose a very sparse mineralization with tetradymite, and samples taken assayed only a trace of gold.

At elevation 2,890 feet, directly below the main workings, a band of tuff is silicified over a width of 2 feet along its upper contact with andesite on the northeast side of the talus slide. A 2-foot chip sample taken across the silicified tuff 40 feet south of the trail to the silver-lead-zinc vein, and a few feet northeast of the talus slide, assayed: gold, 0·045 ounce a ton.

It must be borne in mind that assays from channel samples collected from deposits such as this one, in which the gold occurs free and is erratically distributed, may be misleading. The actual grade of the veins can probably be more accurately judged from samples in bulk.

A silver-lead-zinc vein lies between elevations of 2,850 and 3,300 feet about 700 feet northeast of the gold-bismuth deposits. It extends up a steep slope through a vertical distance of 450 feet and a horizontal distance of 500 feet. The vein occurs along a fault fissure and is enclosed in fine-grained andesite flows except at the upper end where it passes into tuffs. It strikes from south 20 to 40 degrees west and dips from 40 to 60 degrees northwest. The vein consists of banded alternations of calcite, siderite, galena, sphalerite, arsenopyrite, and pyrite, with a little quartz and in places some tetrahedrite. It ranges from 4 to 18 inches in width. The wall-rock adjoining the vein is bleached for widths of a few inches to 1 or 2 feet.

At elevation 2,950 feet an adit has been driven 80 feet southwest along the vein. In the adit the vein ranges from 5 to 10 inches wide and is mineralized throughout. An 8-inch channel sample taken across the vein

from the roof of the adit, 10 feet from the portal, assayed: gold, 0·015 ounce a ton; silver, 6·58 ounces a ton; lead, 4·41 per cent; zinc, 1·66 per cent. A 6-inch channel sample taken across the vein on the face of the adit assayed: gold, 0·06 ounce a ton; silver, 17·69 ounces a ton; lead, 1·10 per cent; zinc, 2·66 per cent.

Above the adit the vein is exposed for 180 feet up a 47-degree slope. Along this section it has an average width of 6 or 8 inches and is well mineralized. At elevation 3,085 feet, in a 14-foot adit, the vein is 4 inches wide and contains abundant sulphides. A 4-inch channel sample taken across the vein in the roof of the adit, 3 feet from the portal, assayed: gold, 0·14 ounce a ton; silver, 18·14 ounces a ton; lead, 9·55 per cent; zinc, 9·54 per cent.

In an open-cut at elevation 3,235 feet the vein consists of 6 inches of sheared and silicified andesite replaced by and cut by stringers of pyrite, arsenopyrite, galena, tetrahedrite, and sphalerite. A 6-inch channel sample taken across the vein in this cut assayed: gold, 0·05 ounce a ton; silver, 28·75 ounces a ton; lead, 2·39 per cent; zinc, 1·26 per cent.

In the topmost cut at elevation 3,285 feet the vein is enclosed in volcanic tuffs and consists of 5 inches of sheared and altered rock replaced by about 10 per cent of pyrite.

Victory Group (53)

References: Ann. Repts., Minister of Mines, B.C.: 1908, p. 64; 1911, p. 116; 1914, p. 216; 1917, p. 113; 1918, p. 118; 1919, p. 102; 1922, p. 111; 1923, p. 109; 1925, p. 136; 1927, p. 136; 1928, p. 161; 1930, p. 240. Geol. Surv., Canada, Sum. Repts.: 1908, p. 44; 1925, pt. A, p. 134. B.C. Dept. of Mines, Bull. No. 1, 1932, p. 53.

The Victory, Triumph, and Standard claims, owned by Mrs. D. C. Simpson of Smithers, are on the southwest slope of Hudson Bay Mountain, 8 miles due west or 18 miles west by good motor road from Smithers.

The claims were staked by D. C. Simpson about 1906 and development work was carried out each year until 1918, when a carload of silver-lead-zinc ore was shipped to the smelter. In 1919 the Skeena Mining and Milling Company was organized to develop both the Victory and Coronado groups. The company commenced work on the latter property, but operations were soon suspended. In 1927 and 1928 the John J. O'Brien Company did considerable underground work, but later dropped their option. During 1938 a small shipment of hand-sorted silver-lead ore was sent to Prince Rupert.

Rhyolitic and andesitic flows and flow breccias, tuffs, and breccias outcrop in the vicinity of the workings and form the wall-rocks of the mineral deposits, which are sulphide replacements and fissure fillings along sheared zones and faults. The sulphides present, in order of abundance, are as follows, arsenopyrite, galena, sphalerite, tetrahedrite, and chalcopyrite. The sheared wall-rock adjacent the deposits is bleached to a light yellow colour and is silicified. Fault striæ commonly plunge 25 to 30 degrees southwest. In the vicinity of the camp buildings and elsewhere below an elevation of 3,750 feet, the volcanic rocks are concealed by a shallow covering

of sedimentary rocks, conglomerate, slates, and greywacke, which dip in a southerly direction down the slope of the mountain. The basal member of the sedimentary series, a conglomerate, contains abundant dark-coloured pebbles and small boulders of volcanic rock and exceeds 30 feet in thickness. The main mineral deposit may extend southwest into the sediments as a 3-inch wide fissure that was seen along its strike 200 feet southwest of the portal of the main adit above the road.

The main mineralized zone is richest in galena, sphalerite, and tetrahedrite near the sedimentary rocks. This type of ore is most valuable for its silver content. Farther northeast and at higher elevations it contains much more arsenopyrite and only a little sphalerite and galena. This arsenopyrite-rich ore commonly carries considerable gold.

The Victory zone, the main zone, is prospected by four adits and a dozen open-cuts for 1,300 feet up a 27-degree slope between elevations of 3,750 feet and 4,350 feet, and is known to exceed 1,600 feet in length. It ranges from 1 inch to 6 feet wide, strikes northeast, and dips steeply. Below 3,950 feet it splits, but higher up it is a single zone of shearing.

There are 820 feet of drifting and crosscutting in the main adit at elevation 3,750 feet (barometer reading). For 100 feet northeast from the portal, the zone in the roof of the adit ranges from 2 to 15 inches in width. It consists of sheared and altered rhyolitic rock replaced by galena, sphalerite, tetrahedrite, and arsenopyrite. Commencing at the portal, and for 25 feet northeast, the roof is stoped out for 4 feet upwards, and at 70 feet from the portal there is a stope 10 feet long and 8 feet high. Between 100 feet and 260 feet from the portal the adit follows a very narrow, sparsely mineralized fissure. Then the adit runs east as a crosscut for 355 feet. At 180 feet along the crosscut a vein is intersected and was explored by 117 feet of drifting. This vein ranges from 2 to 8 inches in width, with an average of 4 inches of solid sulphides, of which arsenopyrite is dominant. This is believed to be the downward continuation of the main zone, and the one followed for 100 feet from the portal is presumably a branch from the main zone. A 4-inch channel sample taken across the zone in the roof of the adit, 50 feet from the portal, assayed: gold, 0·65 ounce a ton; silver, 6·52 ounces a ton; lead, 3·42 per cent; zinc, 11·90 per cent. A 5-inch channel sample taken across the main zone from the roof of the drift, 30 feet northeast from the 355-foot crosscut, assayed: gold, 0·42 ounce a ton; silver, 14·64 ounces a ton; lead, 23·45 per cent; zinc, 13·36 per cent.

No. 2 adit at elevation 3,965 feet follows the main zone for 160 feet. There the zone ranges from 1 to 4 feet in width, and its mineral content is variable. At the portal there are two sulphide seams, each 2 to 4 inches wide, separated by 4 feet of altered, cross-fractured andesite with numerous, small sulphide stringers. The zone narrows gradually towards the northeast. At a distance of 25 feet from the portal, it is 18 inches wide and consists of at least 90 per cent sulphides, there being about equal proportions of galena, sphalerite, and arsenopyrite, with some tetrahedrite and a little chalcopyrite. An 18-inch channel sample taken across this part of the zone, 30 feet from the portal, assayed: gold, 0·16 ounce a ton; silver, 13·62 ounces a ton; lead, 23·20 per cent, zinc, 27·93 per cent. Farther along the proportion of altered rock increases. At 75 feet from the portal the zone

is 3 feet wide and carries only 3 to 5 per cent of sulphides. Twenty-five feet farther along it narrows to 18 inches and mineralization consists of scattered sulphide impregnation along both sides of a narrow fissure. The drift leaves the vein for the next 50 feet, but swings back across it for 10 feet at the face. Ten feet from the face the zone is 22 inches wide and carries up to 15 per cent of sulphides, chiefly arsenopyrite but with some small pockets of galena and sphalerite. A 22-inch channel sample taken across the deposit at this point assayed: gold, 0·045 ounce a ton; silver, 2·44 ounces a ton; lead, 2·78 per cent; zinc, 2·11 per cent. At the face the sheared zone is 33 inches wide and carries about 5 per cent of arsenopyrite and 1 per cent of sphalerite.

No. 3 adit at elevation 4,080 feet, 225 feet farther up the hill, is 22 feet long. At the face the zone consists of 3 feet of altered and sheared andesite with stringers and pockets of arsenopyrite with a little galena and sphalerite. In an open-cut 70 feet farther up the slope the zone is similarly mineralized across a width of 6 feet. About 90 feet farther, at elevation 4,165 feet, the zone is 24 inches wide and carries over 20 per cent of sulphides, about half of which is arsenopyrite and the remainder sphalerite with a little chalcopyrite. The No. 4 adit at elevation 4,207 feet follows the zone for 41 feet. For 30 feet from the portal the zone consists of altered, fractured andesite well mineralized with stringers and impregnations of arsenopyrite with very little galena or sphalerite. At the face, a fracture on the northwest side carries from 1 to 3 inches of arsenopyrite and another on the southeast side of the adit lies in the middle of a zone 12 inches wide that is impregnated with disseminated arsenopyrite. The intervening rock is largely barren.

The following assays are of samples collected by Duthie Mines prior to 1930. A 31-inch channel sample from the face of No. 3 adit assayed: gold, 0·20 ounce a ton; silver, 9·7 ounces a ton; lead, 7·4 per cent; zinc, 9·2 per cent. A 55-inch channel sample taken across the zone in the cut 70 feet above No. 3 adit assayed: gold, 0·13 ounce a ton; silver, 3·6 ounces a ton; lead, 0·4 per cent; zinc, 3·8 per cent. From the next open-cut, 160 feet up the slope from No. 3 adit, a 29-inch channel sample assayed: gold, 0·16 ounce a ton; silver, 1·8 ounces a ton; lead, 1·2 per cent; zinc, 3·2 per cent. A 48-inch channel sample taken from the zone in the cut at the portal of No. 4 adit assayed: gold, 0·65 ounce a ton; silver, 7·4 ounces a ton; lead, 6·4 per cent; zinc, 1·1 per cent.

According to D. Lay,[1] there is an ore shoot in the immediate vicinity of No. 4 adit, 60 feet long, 3·7 feet wide, assaying: gold, 0·44 ounce a ton; silver, 10·45 ounces a ton; lead, 7·10 per cent; zinc, 5·49 per cent.

In a cut 100 feet up the slope from No. 4 adit, the zone continues as a sparsely mineralized sheared zone 18 inches wide. At elevation 4,340 feet, 250 feet up the slope from No. 4 adit, the zone consists of 6 inches of sheared andesite with stringers of arsenopyrite. It is 50 feet farther to the last open-cut, beyond which the zone passes under a small basin and is concealed by drift for several hundred feet. In the last open-cut the

[1]B.C. Department of Mines, Bull. No. 1, 1932, p. 53.

silicified, sheared zone is 18 inches wide and carries about 3 per cent of arsenopyrite with a sparse dissemination of galena and sphalerite. An 18-inch channel sample taken across the zone in this cut assayed: gold, 0·165 ounce a ton; silver, 2·10 ounces a ton.

Mamie Group (54)

References: Ann. Repts., Minister of Mines, B.C.: 1917, p. 113; 1919, p. 103; 1921, p. 107; 1922, p. 107; 1923, p. 108; 1924, p. 96; 1934, p. C7; 1935, p. C35. B.C. Dept. of Mines, Bull. No. 1, 1932, p. 32. Geol. Surv., Canada, Sum. Rept. 1925, pt. A, p. 132; Ec. Geol. Ser. No. 4, 1927, p. 40.

This property, owned by the estate of J. Aldrich, is on the southwest slope of Hudson Bay Mountain, 7 miles due west of Smithers. It is reached by a branch trail half a mile in length from the Duthie mine camp, which is connected by a 15-mile motor road with Smithers. The Mamie group consists of the Myrtle, Iron King, Dome Extension, Florence, Evinrude, and Mamie claims. The Mamie "vein" outcrops on the last-named claim and extends northeasterly up the mountain towards the adjoining Evinrude claim.

Prior to 1919 the Mamie "vein" was developed by surface stripping, open-cuts, and a 20-foot shaft. An option was obtained in 1919 by J. R. Turner for J. F. Duthie, and early in 1920 an adit was driven 125 feet along the Mamie "vein" at elevation 4,427 feet. During 1922 the drift was continued to 165 feet and two winzes, 50 feet apart, were sunk to depths of 25 and 17 feet, respectively. An adit was started from the Henderson Creek gorge at elevation 3,840 feet, 587 feet below the upper adit. This adit, designed to intersect the Mamie vein 950 feet from the portal, was driven 200 feet before work ceased. During 1923 Duthie Mines started a new adit along the strike of the Mamie vein 154 feet below the upper adit. The Federal Mining and Smelting Company, which held a 55 per cent interest in Duthie holdings in 1934, continued this adit to about 660 feet to a position nearly below the No. 1 winze of the upper adit. In 1934, W. R. Wilson and Sons obtained an option. The upper adit was extended to a total length of 240 feet and some surface work was done.

Massive, finely crystalline tuffs and andesite flow breccias containing fragments over an inch in diameter, form the country rock in the vicinity of the "vein". These rocks range from dark grey to light grey, and adjoining the "vein" have been altered and bleached.

The "vein" is a sheared zone carrying sphalerite and arsenopyrite with a little chalcopyrite and, rarely, some galena. Parts of the zone are brecciated and consist of small, angular rock fragments cemented by and partly replaced by the sulphides.

The zone strikes north 65 degrees east and dips about 80 degrees southeast. It is exposed by stripping for 300 feet along its strike up an 18-degree slope between elevations of 4,444 and 4,540 feet. In this distance it ranges from 2 to 8 feet in width. At the lower end it carries more than 50 per cent of sulphides across 7 feet. About 120 feet northeast it consists of 12 inches of greyish white quartz containing 10 per cent of arsenopyrite

with 3 feet of adjoining, sparsely mineralized, sheared, altered tuff. The zone at the 20-foot shaft (elevation 4,510 feet) contains from 25 to 30 per cent sulphides across 6½ feet. At the northeast end of the stripped section, the zone carries 15 to 20 per cent of arsenopyrite and sphalerite across 7½ feet.

The following assays are of samples collected and assayed by Duthie Mines, Limited. A sample across 6·5 feet at the lower end of the stripped zone assayed: gold, 0·57 ounce a ton; silver, 2·40 ounces a ton; zinc, 9·5 per cent. A sample across 6·5 feet, taken 60 feet southwest of the shaft, assayed: gold, 0·24 ounce a ton; silver, 1·2 ounces a ton. At the shaft a sample across 3·5 feet assayed: gold, 0·50 ounce a ton; silver, 17·60 ounces a ton; zinc, 21·5 per cent. A sample across the remaining 3 feet assayed: gold, 0·24 ounce a ton; silver, 1·3 ounces a ton. At the northeast end of the stripped zone a sample across 7·5 feet assayed: gold, 0·27 ounce a ton; silver, 2·0 ounces a ton; zinc, 3·9 per cent.

The upper adit at elevation 4,427 feet follows the zone below the stripped section for 200 feet. The zone ranges from 6 feet in width at the No. 1 winze to 3·6 feet at the face of the drift. It contains up to 80 per cent arsenopyrite and sphalerite across several feet in the richest looking parts of the vein. At the face the zone carries 30 per cent sulphides across 2 feet and 5 per cent of sulphides across the remaining 20 inches. A 33-inch channel sample collected by the writer across the zone in the face assayed: gold, 0·98 ounce a ton; silver, 2·02 ounces a ton; zinc, 12·89 per cent. Samples collected at 5-foot intervals and assayed by the company, from near the No. 1 winze, gave: across 5·6 feet, 0·32 ounce of gold a ton; across 3·0 feet, 0·76 ounce of gold a ton; across 3·5 feet, 0·46 ounce of gold a ton; across 4 feet, 0·90 ounce of gold a ton.

The lower adit, at elevation 4,273 feet, follows the zone for 660 feet. On this level there are several, small, parallel zones over a width of 30 or 40 feet. In general the mineralization is weak in comparison with that in the upper adit. At 65 feet from the portal, a 24-foot crosscut to the northwest intersects a 2-foot sheared zone that carries an average of 5 per cent of sphalerite and arsenopyrite across 20 inches. Company assays for this part of the zone are as follows: across 3·5 feet, gold, 0·10 ounce a ton; across 0·5 feet, gold, 0·47 ounce a ton; silver 16·4 ounces a ton; zinc, 11·2 per cent. This zone strikes north 75 degrees east and dips steeply. It is intersected again by the main adit drift 100 feet from the portal, and there passes into the east wall of the drift. About 40 feet farther along the drift a small fissure appears and is followed northeast for 400 feet. At 540 feet from the portal the drift turns east as a crosscut and the fissure runs into the north wall at the bend. For the greater part of the 400-foot stretch the fissure carries a vein filling of arsenopyrite and sphalerite ranging from 1 to 4 inches in width. For a distance of 100 feet, between 350 and 450 feet from the portal, the deposit is wider, consisting of a mineralized sheared zone ranging from 1 to 4 feet in width. According to company assays, twenty-one samples collected at 5-foot intervals along this section give a weighted average of 0·2 ounce of gold a ton across 1·58 feet.

From 540 to 600 feet from the portal, the drift runs east as a crosscut and from 600 to the face at 660 feet it runs northeast again, following

three roughly parallel " veins ". These " veins " lie 30 to 40 feet southeast of the fissure followed for 400 feet and may connect with the sheared zone that crosses the adit 100 feet from the portal. The three " veins " are 150 feet vertically below the rich sector of the main zone exposed in the southwest end of the upper adit. Presumably, they unite somewhere between the two levels to form the wider zone. Where visible for 60 feet along the drift and in short crosscuts, the three " veins " range from 1 to 10 inches in width and are well mineralized with arsenopyrite. Company assay plans show for a length of 35 feet from the face of the drift, 0·03 to 0·07 ounce of gold a ton across widths of 5 feet. These samples include several feet of barren rock.

The extent of the zone northeast of the 300-foot stripped section is not well known. Two open-cuts along the strike, 140 and 335 feet, respectively, northeast of the stripped section, are now slumped in and only small amounts of rusty, altered rock are visible on the dump. In a third cut, 70 feet farther along, there is a 3-foot wide sheared and silicified zone that carries 3 to 5 per cent of arsenopyrite associated with quartz. This sheared zone strikes north rather than northeast and dips steeply. Bedrock is visible in three trenches that lie between elevations of 4,650 and 4,700 feet, but in none of them is there evidence of the presence of the zone. In the bed of Henderson Creek 1,000 feet northeast of the stripped section there is a sheared zone, 4 feet wide, exposed for about 50 feet. The sheared rock is altered and bleached and contains narrow, sparsely mineralized lenses of quartz. In the northeast bank of the creek, one of these attains a width of 12 inches and carries up to 20 per cent of arsenopyrite and sphalerite with a little chalcopyrite. A 12-inch channel sample taken across it assayed: gold, 0·285 ounce a ton; silver, 1·01 ounces a ton; zinc, 5·74 per cent.

Other small exposures of vein materials occur farther northeast along the same general strike.

Coronado Group (55)

References: Ann. Repts., Minister of Mines, B.C.: 1911, p. 118; 1912, p. 114; 1913, p. 107; 1914, p. 213; 1915, p. 77; 1919, p. 102; 1933, p. 97. Geol. Surv., Canada, Sum. Rept. 1908, p. 44; 1925, pt. A, p. 132.

The Coronado property is on the southwest slope of Hudson Bay Mountain about 16 miles west by road from Smithers. The workings are half a mile northwest of the Duthie mine and lie between elevations of 3,400 and 3,650 feet. A good road crosses the claims a short distance below the mineralized zones.

This group is one of the earliest mineral locations staked on Hudson Bay Mountain. In 1905, the owners, J. R. McDonald, Simpson, and Fleming, sent out 4 or 5 tons of hand-sorted galena ore by pack-horses to Hazelton and thence to the smelter via boat on Skeena River. Between 1912 and 1914, extensive development work was undertaken, the zones being explored by four adits and by open-cuts and stripping. A shipment of 60 tons of silver-lead ore was made early in 1915. In 1919 the Skeena Mining and Milling Company was organized to develop the Victory and

Coronado groups. Mining machinery and a 50-ton capacity Faust water concentrating mill were purchased, and some of this equipment was hauled to the property. Fred Griffin carried out shallow surface operations during 1938 and 1939 and shipped selected silver-lead ore in both years.

There are two parallel zones on the property, 950 feet apart, that strike north 45 degrees east and dip from 75 to 85 degrees southeast. The zones are in rhyolite and andesite flows and andesitic flow breccias. The zones are fault or sheared zones, along which the wall-rock is bleached and silicified. Galena, sphalerite, tetrahedrite, and arsenopyrite, with a little chalcopyrite, occur as fissure fillings replacing the altered rock. A little quartz gangue accompanies the sulphides. Arsenopyrite is the dominant sulphide in the wall-rock, and assays show that it is accompanied by some gold.

The more westerly zone is prospected for 600 feet along its strike by three adits and several open-cuts. The No. 1 or lower adit, at elevation 3,430 feet, follows the zone for 260 feet. From the portal a single fissure, sparsely mineralized, is followed for 20 feet to where it splits. The two branches lie 2 to 3 feet apart and continue along the walls of the adit. Between the two fissures, altered silicified rhyolite is cross fractured and traversed by small stringers of sulphides. A lens 8 inches wide, containing over 60 per cent sulphides, occupies the west branch between 20 and 30 feet from the portal. Another sulphide lens, 12 inches wide, 110 feet from the portal carries about 50 per cent sulphides. From there to the face of the adit, the two fissures lie from 3 to 6 feet apart and carry sulphide lenses up to 6 inches in width. At the face, 36 inches of sheared, silicified rock is replaced by about 3 per cent of arsenopyrite. A 36-inch channel sample taken across the face assayed: gold, 0·035 ounce a ton; silver, 0·63 ounce a ton.

No. 2 adit, 90 feet in length, is 250 feet farther up the hill and 75 feet vertically above the lower. For 20 feet northeast from the portal ore has been stoped from the back of the drift. Between 20 and 40 feet from the portal the zone is 12 inches wide, and beyond this gradually narrows until it pinches out entirely at the face of the drift. The better parts of the zone are solid sulphides, consisting of about equal amounts of argentiferous galena, arsenopyrite, and sphalerite, with a little tetrahedrite and chalcopyrite. Several tons of ore is piled in a dilapidated cabin near the portal. A representative sample of this ore assayed: gold, 0·36 ounce a ton; silver, 20·66 ounces a ton; lead, 16·96 per cent; zinc, 12·06 per cent.

No. 3 adit is 80 feet farther up the slope and 30 feet above No. 2 adit. It follows two parallel zones 3 to 4 feet apart. Both sheared zones are under 3 inches in width and are very sparsely mineralized.

In an open-cut 150 feet farther up the hill, at an elevation of 3,610 feet, the zone ranges from 12 to 30 inches in width and carries about 30 per cent of sphalerite, arsenopyrite, and galena. In a second cut, 60 feet farther along, the zone has a maximum width of 2 feet and consists of three parts: a vertical, sheared zone 6 inches wide, carrying 5 per cent of arsenopyrite; a 4-inch fissure zone containing 50 per cent arsenopyrite; and 2 feet of intervening, altered breccia, cross fractured, silicified, and mineralized with about 2 per cent of arsenopyrite.

The more easterly zone is traced for 400 feet along its strike by an adit and several open-cuts. The adit, at elevation 3,400 feet, follows two or more roughly parallel fissures 4 to 5 feet apart, for a distance of 62 feet. These are largely barren for 40 feet from the face of the adit, but near the portal carry narrow sulphide seams ranging from 2 to 6 inches in width. Above the adit some ore was removed years ago, as evidenced by a trench 6 feet deep that follows along the zone for 75 feet. In a large open-cut 350 feet up the hill from the adit there is a 12-inch zone of brecciated, sheared rhyolite carrying galena, sphalerite, and a little tetrahedrite. The zone strikes north 35 degrees east and dips 75 degrees southeast. Along its northwest side, in a distance of 12 or 15 feet, it is joined by several branch fissures. They lie several feet apart, strike south 65 degrees west, and dip steeply southeast. They do not extend over 20 or 30 feet from the main fissure, but near the latter carry 1 to 2 inches of almost solid sulphides, chiefly galena and sphalerite and some tetrahedrite. At the surface this ore is oxidized to a soft, rusty, friable material with a yellowish white oxidation product dusted over it. A sample of this material assayed: gold, 0·06 ounce a ton; silver, 24·42 ounces a ton; lead, 11·13 per cent; zinc, 7·83 per cent.

Henderson Group (Duthie Mine) (56)

References: Ann. Repts., Minister of Mines, B.C.: 1908, p. 64; 1914, p. 216; 1922, p. 109; 1923, p. 108; 1924, p. 94; 1925, p. 135; 1926, p. 129; 1927, p. 134; 1928, p. 159; 1929, p. 161; 1930, p. 139; 1934, p. C9. Geol. Surv., Canada, Sum. Repts.: 1908, p. 45; 1925, pt. A, p. 130; Prel. Rept., Paper 36-20, 1936, p. 88.

The Duthie mine (*See* Figures 9 and 10) is on the southwest slope of Hudson Bay Mountain 7½ miles west of Smithers. The principal mine workings (*See* Figure 9) are between elevations of 3,200 and 4,000 feet on the Raven, Raven Fraction, Henderson, and Hummingbird mining claims. These claims belong to the Henderson group, which includes the Canary, Galena Queen, Dome, Dome Fraction, White Swan, Pacific, and Vancouver Crown granted claims. The property is owned by J. F. Duthie of Seattle. A good motor road about 15 miles long connects the mine with the Canadian National Railway at Smithers.

The mine has not been operated since 1930, but in earlier years was well known as a producer of silver, lead, and zinc. Most of the ore mined came from the Henderson vein-lode on the Henderson mining claim. The Ashman and Fault Plane vein-lodes also furnished considerable ore.

The British Columbia Minister of Mines reports record surface work by Boyd and J. K. Ashman on the Henderson claim, and by M. Hannah, G. Holbrook, and Geo. Charlton on the Hummingbird claim in 1908. On the Henderson claim the early work was confined to the Ashman vein-lode, but following the discovery of the Henderson vein-lode in 1921 and the disclosure of its high silver content, the property was bonded by J. F. Duthie. Underground operations commenced in 1922 with the driving of three drift adits known as the Compressor, McPherson, and Thompson levels. In 1923 the Federal Mining and Smelting Company obtained a controlling interest, and an operating company known as Duthie Mines,

Limited, was formed. A vigorous development campaign was carried out and some high-grade ore was shipped, but work stopped in August 1924. Mining was resumed by Duthie Mines, Limited, in July 1925, and in 1926 further shipments of high-grade, hand-sorted ore were made. In 1927 a modern 50-ton flotation mill (*See* Plate IV) was built, and 5,500 tons of ore were treated by the end of the year. A 680-foot crosscut adit was driven at the mill level to reach the Henderson and Fault Plane lodes. Development continued on this mill level in 1928 and 14,980 tons of ore was milled. In the same year Duthie Mines, Limited, became associated with the Atlas Exploration Company of Ottawa and Mining Issues Corporation of Toronto. A new boarding-house, bunk-house, and other surface buildings were constructed in 1929, and extensive mining development was accomplished. A 600-horsepower, steam driven, electric power plant was completed and a three-compartment shaft was sunk from the mill (500) level to the 600 level. Twelve thousand five hundred tons of ore was mined during the year and 10,370 tons milled. The Hummingbird and Canary claims were purchased towards the end of the year, giving an additional 2,000 feet along the northeasterly continuation of the Henderson lode for further exploration. Mining operations were suspended in March 1930, owing to the depressed metal market. The property is still held by J. F. Duthie of Seattle.

The following statement of total production from the Duthie mine is from the Annual Report of the British Columbia Minister of Mines for 1934.

"4,788 tons of hand-sorted ore yielding gross smelter returns of $523,744.92, leaving net smelter returns of $411,705.72, after deducting freight and treatment rates of $23.40 a ton; 31,956 tons of ore milled yielded 1,663 tons of lead concentrates and 1,834 tons of zinc concentrates. Values contained in the tonnage milled were as follows: gold, 776 oz.; silver, 739,055 oz.; lead, 1,920,487 lb.; zinc, 1,606,014 lb. The following may be taken to represent the average tenor of the various products:—

Feed: Silver, 37·2 oz. per ton; lead, 4·8 per cent; zinc, 5·2 per cent.

Lead Concentrates: Gold, 0·27 oz. per ton; silver, 430·8 oz. per ton; lead, 48·6 per cent; zinc, 10·9 per cent.

Zinc Concentrates: Gold, 0·093 oz. per ton; silver, 36 oz. per ton; lead, under 1·4 per cent; zinc, 47·2 per cent. Savings effected, 95 per cent of silver contents, 95 per cent of lead contents, and 80 per cent of zinc contents".

The principal vein-lodes, known as the Ashman, Henderson, and Fault Plane, are developed by several miles of underground workings and have furnished all the ore taken from the mine. There are nine levels, four of which are adit drifts. From top to bottom they are named or numbered as follows: Thompson or -10, McPherson or 65, Intermediate or 145, Compressor or 245, Mill or 500, and sub-levels 265, 300, 400, and 600. The numbers denote the vertical distances below an elevation of 3,840 feet, 10 feet below the Thompson level.

The property is underlain by rhyolite, dacite, and andesite flows and flow breccias and by rhyolite tuffs (*See* Figure 9). The mine workings above the 500 level (600 level was not examined) are in rhyolite flows and silicified rhyolite tuffs. These rocks are overlain on the east and south

by rhyolite, dacite, and andesite flow breccias. Light-coloured, fine-grained rhyolite is the most common rock in the vicinity of the workings. It exhibits well-developed flow structure, and some of the individual flows are packed with spherulites. Thirty feet north of the McPherson portal, an outcrop of spherulitic rhyolite is composed largely of spherulites ranging from one-eighth to three-eighth inch in diameter, arranged in parallel bands through flowage. A specimen of spherulitic rhyolite taken from the dump of the Compressor level contains spherulites up to an inch in diameter. The rhyolite tuffs are very fine-grained, light yellowish white to grey rocks. Most of them are finely laminated and have been silicified so that they are as hard and brittle as the rhyolite. A small mass of rhyolite flow breccia is intercalated with the rhyolite flows 500 feet north of the north portal of the Compressor level and another small mass occurs on the surface 150 feet northeast of the Thompson portal.

The flow breccias, in which the Dome and the combined Henderson-Ashman vein-lodes occur, are dominantly dacites, but some are andesites and some are rhyolite. These lavas contain abundant angular fragments ranging up to 3 inches in diameter with an average size of about one-half inch. There are both chert-like fragments of the same composition as the matrix and variegated white, purple, grey, and black fragments of tuff and lava.

Near the McPherson portal, spherulitic rhyolite and tuff beds strike northwest and dip 70 to 80 degrees northeast. Farther northeast the rocks have a comparable strike and may be seen in many places dipping 60 to 85 degrees northeast. Two hundred and fifty feet southwest of the McPherson portal the flows also strike northwest, but dip 65 degrees southwest. Four hundred feet southwest of the McPherson portal the structure is interrupted by a strong fault (No. 1 fault), which strikes northwest and dips 80 degrees southwest. Tuff beds southwest of the No. 1 fault on the 500 level strike from north to northwest and dip 30 degrees southwest to west, but commencing 300 feet northeast of the fault the rocks on this level strike northwest and dip from 25 to 87 degrees northeast. The major structure then is an anticlinal fold the axial plane of which strikes northwest and appears to dip at a steep angle to the southwest. On the surface the crest of the anticline lies about 150 feet southwest of the McPherson portal and the No. 1 fault runs along its southwest limb. This major fold is masked by smaller folds, which were seen on the surface south of the No. 1 fault and also north of the north portal of the Compressor level. The anticline plunges at a low angle to the southeast judging by the presence of overlying flow breccias in that direction.

One diorite dyke, a quartz-albite porphyry dyke, and numerous dykes of lamprophyre and albite porphyry intrude the volcanic rocks (*See* Figure 9). Medium to coarsely crystalline, grey diorite forms a dyke, 50 to 60 feet wide, which trends northwesterly across the Henderson claim and dips about 80 degrees northeast. This dyke is intersected by the McPherson adit 775 feet from the portal, and is entered for 21 feet at the face of the Mill level drift along the Henderson vein-lode. Where crossed by the Henderson vein-lode on the McPherson level, it is fractured, altered, and bleached, but the fissures do not carry vein minerals.

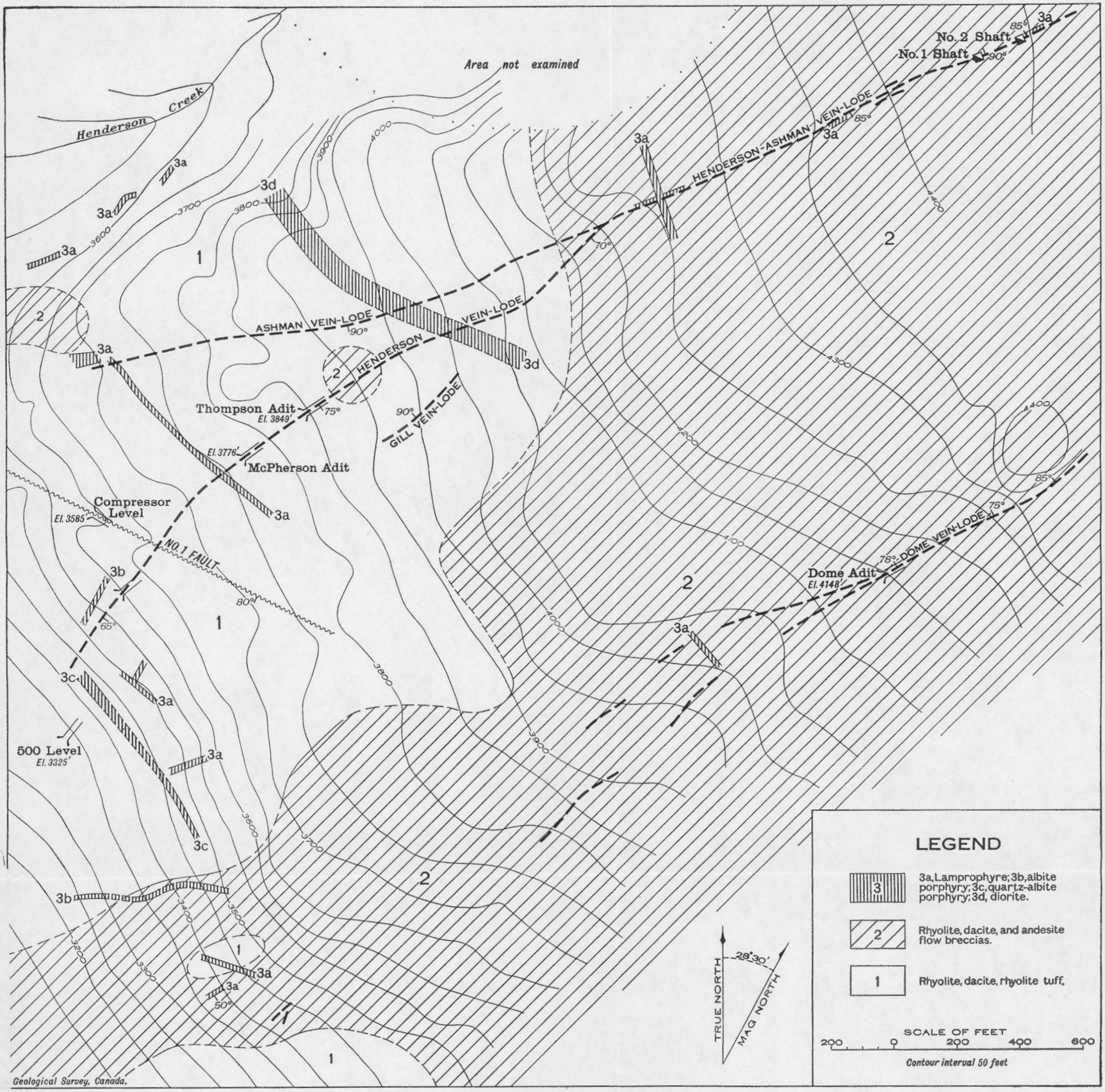


Figure 9. Plan of Duthie mine property (Henderson group).

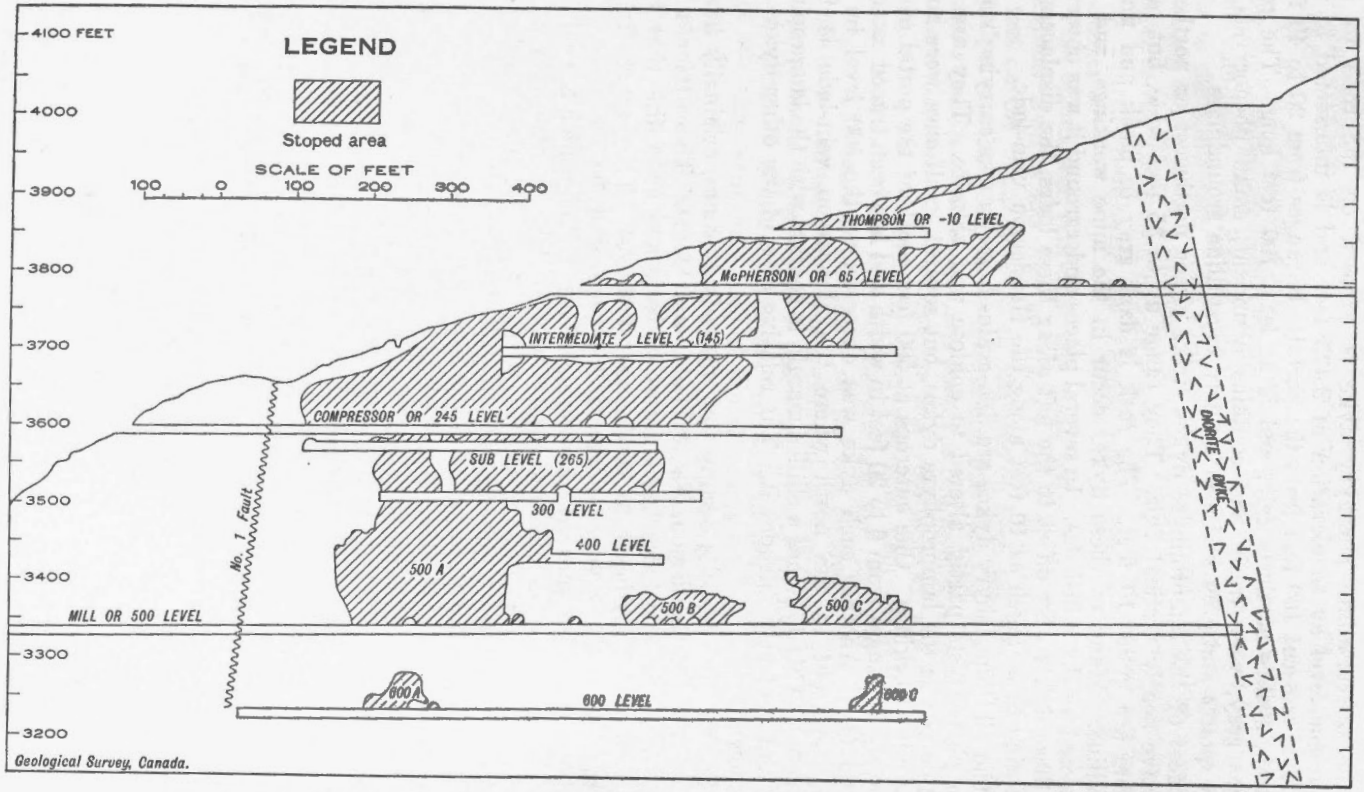


Figure 10. Vertical section along Henderson vein-lode, Duthie mine; showing stoped areas.

The quartz-albite porphyry dyke is exposed on the road to the Compressor level at an elevation of 3,475 feet and is intersected in the Mill level crosscut 160 feet from the portal. It ranges from 20 to 40 feet in width, strikes northwesterly, and is at least 700 feet long. The rock is light grey, very fresh, and contains abundant, small phenocrysts of glassy quartz and grey albite in a finely crystalline groundmass.

Most of the lamprophyre dykes strike either northwest or northeast and have nearly vertical dips. They range up to 35 feet wide, but most of them are under 10 feet. The rock is dark grey to black and finely crystalline. Many of these dykes occur in the mine workings, and are intersected by the vein-lodes. In several places underground it was observed that these dykes were offset to the left along these lodes, the displacement amounting to as much as 10 feet along the Henderson vein-lode.

The albite porphyry dykes are fine-grained, grey rocks carrying small, albite phenocrysts partly altered to epidote and chlorite. They are not as numerous as the lamprophyre dykes, but several small ones were noted in the mine workings. One outcrops at 500 feet south of the portal of the 500 level. It ranges from 6 to 20 feet in width and has been traced easterly for 500 feet. Another such dyke was observed on the 500 level in the 40-foot crosscut to the north where the Henderson vein-lode is first intersected. This dyke has a chilled margin in contact with the lamprophyre dyke and evidently intrudes it. The relative ages of the other dykes are not known.

The mineral deposits occupy four main fault zones, originally known as the Ashman, Henderson, Fault Plane, and Dome. These mineralized fault zones or "vein-lodes" strike northeasterly and have dips that vary from 50 degrees southeast to 70 degrees northwest. They range from a few inches to 8 feet wide and from 700 to over 3,500 feet long. The vein-lodes are sliced, sheared, and brecciated zones along which are sulphide vein fillings and replacement deposits associated with some vein quartz and carbonate. The ore minerals are galena, sphalerite, tetrahedrite, ruby silver (pyrargyrite), pyrite, arsenopyrite, and chalcopyrite. The writer saw no ruby silver in place, but was shown specimens taken from the Ashman, Henderson, and Fault Plane lodes during stoping operations. The ore also contains values in gold, but no free gold was seen.

The Henderson vein-lode is marked by stronger slicing and brecciation than the other vein-lodes and has proved to be the most productive on the property. It outcrops at intervals along the surface for over 2,000 feet between elevations of 3,550 and 4,200 feet, at which point it is joined by the Ashman vein-lode. Beyond this point the combined lodes have been traced up the hill northeasterly in line with the Ashman lode for a distance of 1,500 feet to an elevation of 4,450 feet. The Henderson lode has an average strike of about north 65 degrees east and a dip that varies from 50 degrees southeast to 80 degrees northwest. The Ashman lode has been traced for about 1,700 feet to the southwest of its junction with the Henderson. As exposed in surface cuts this lode is not sliced and brecciated as severely as the Henderson and the vein deposits that occur along it are relatively small. The Ashman and Henderson vein-lodes come together

on the McPherson level 1,240 feet northeast of the portal. Their line of junction between this level and the surface plunges 75 degrees to the southwest.

At an elevation of 3,575 feet northeast of the No. 1 fault, and just below the Compressor level, the Henderson vein-lode is joined by the Fault Plane vein-lode. The line of junction of these two lodes plunges at a low angle to the southwest. The stronger, Henderson vein-lode has a vertical dip below the junction, whereas the Fault Plane vein-lode strikes roughly parallel to the Henderson but dips at 55 to 60 degrees to the southeast.

A fourth vein-lode, the Dome, lies 1,350 feet southeast of the Henderson.

The Henderson vein-lode has been drifted on for 250 feet on the Thompson level, 1,450 feet on the 65 level, 500 feet on the 145 level, 950 feet on the Compressor level, 425 feet on both the 300 and 400 levels, 1,250 feet on the Mill level, and about 900 feet on the 600 level. An extensive system of stopes extends from the 500 level through to the surface, and there are two small stopes on this vein-lode on the 600 level (*See* Figure 10). The commercial silver-lead-zinc vein deposits were found over a length of 1,050 feet at the surface and for 750 feet along the 500 level. The eastern boundary of the ore follows a line that plunges 70 degrees southwest from the upper end of the open stope above the Thompson level. The western boundary of the stoped areas follows a line plunging 77 degrees northeast, so that in longitudinal section (*See* Figure 10) this composite zone of ore shoots is seen to narrow at depth. Judging from mine assay plans, the ore mined ranged from 6 inches to 4 feet in width and assays exceeding 100 ounces of silver a ton were not uncommon over widths of 12 to 15 inches. A series of fifty-three samples taken at 5- or 6-foot intervals along the roof of stope 500A, 90 feet above the 500 level, over a length of 280 feet (March 1929), ranged from 7 to 48 inches in width and assayed from 4·6 to 1,120·4 ounces of silver a ton. The average width of the fifty-three samples was 20 inches, and the average grade was 106 ounces of silver a ton. A series of eighteen samples taken close to the present roof of stope 500C (September 1929), over a length of 100 feet, gave an average assay of 51·3 ounces of silver a ton across an average width of 9 inches. Below the 500 level the vein-lode is narrower and values are lower. According to mine assay plans, a series of fifteen samples from stope 600A, taken 30 feet above the floor of the 600 level (December 1929), ranged from 4 to 10 inches in width and assayed from 4·2 to 230·6 ounces of silver a ton. The average width of the fifteen samples was 6·2 inches and the average grade 76·2 ounces of silver a ton. The plans show that the vein-lode in 600C stope also averaged about 6 inches in width, but that the veins assayed under 20 ounces of silver a ton.

Near the portal of the McPherson adit the Henderson vein-lode includes seven parallel fissures spaced across a width of 4 feet. The rhyolite wall-rock is much cross fractured between these fissures, and in one zone is brecciated across a width of from 2 to 12 inches. The brecciated rock fragments in this zone are cemented by vein quartz, sphalerite, arsenopyrite, galena, tetrahedrite, pyrite, and chalcopyrite. Sulphide veins composed of similar minerals occur along the other fissures. These veins

range from ½ inch to 6 inches wide, and average about 1 or 2 inches. This condition is characteristic of small ore shoots seen elsewhere along the Henderson and Fault Plane vein-lodes and probably also applies to much of the ore mined from these lodes.

As the diorite dyke is approached on the McPherson level, the Henderson vein-lode narrows. Individual fissures unite to form two or three tight fractures; there is no cross fracturing and no sulphide-bearing veins. On the northeast side of the dyke the vein is offset for possibly 10 feet to the southeast by a cross fault that lies close to the dyke. From the dyke northeast to the face of the drift, a distance of 600 feet, the vein-lode is well defined. For 200 feet northeast of the dyke there is a single strong fracture along which the rhyolite is replaced over widths of from 2 to 6 inches by quartz, arsenopyrite, sphalerite, and pyrite. A shattered zone 25 feet long, ranging from 1 to 2 feet wide, occurs 240 feet northeast of the dyke. Brecciated rock fragments from 1 to 6 inches in diameter are cemented by sphalerite, arsenopyrite, and vein quartz, with a little galena and tetrahedrite. Four hundred feet northeast of the dyke a strong fissured zone, evidently the Ashman vein-lode, joins the Henderson vein-lode from the northwest. At the junction of these two fissured zones, the rhyolite is highly fractured and silicified over a length of 20 feet and a width of from 2 to 10 feet. The silicified rock is traversed by a network of sphalerite and arsenopyrite stringers, so that the mineralized zone contains about 10 per cent of these sulphides. A representative sample of this rock assayed: gold, 0·045 ounce a ton; silver, 0·53 ounce a ton; (zinc not tested). From 50 to 130 feet northeast of the junction of the two vein-lodes, vein matter consisting of sphalerite, arsenopyrite, and vein quartz, with a little galena, tetrahedrite, and pyrite, forms the matrix of a shattered zone of rhyolite, from 1 to 3 feet wide, composed of small, angular fragments. From 25 to 50 per cent of the lode consists of sulphides, sphalerite being the predominant mineral. The ore is traversed by a few chalcedony veinlets up to 1 inch in width. A grab sample taken from the back, 125 feet from the face, assayed: gold, 0·145 ounce a ton; silver, 0·97 ounce a ton; zinc, abundant but not tested. At the face of the drift are four parallel fissures within a width of 4 feet. Small cross fractures connect them. The fissures contain quartz veins less than an inch wide and the cross fractures are filled with ⅛-inch veinlets of pyrite, sphalerite, and arsenopyrite. A 50-inch channel sample taken across the vein-lode at the face assayed: gold, 0·03 ounce a ton; silver, 0·42 ounce a ton.

On the 500 level, the northeast drift along the Henderson vein-lode ends 20 feet within the diorite dyke. For 400 feet along the drift to the dyke the vein-lode consists of two or more parallel fissures, which here and there contain veins under 4 inches wide. A fault, striking southeast, crosses the drift at the rhyolite and diorite dyke contact and appears to have offset the vein-lode to the southeast. The lode probably continues through and beyond the dyke, as it did on the McPherson level.

The Ashman vein-lode is developed by 210 feet of drifting on the McPherson (65) level, 247 feet of drifting on the Compressor (245) level, 425 feet of drifting on the Mill (500) level, and a 100-foot drift on the 600 level. On the 65 level there are two small stopes in the roof, each

about 40 feet long and 20 feet high. No remaining ore was noted. A lamprophyre dyke, from 2 to 10 feet wide, partly follows the vein-lode on this level and extends down along the vein-lode to the Compressor and Mill levels. At the southwest face (65 level) a lamprophyre dyke, 2 feet wide, dips 70 degrees northwest and is in contact along its hanging-wall with 12 inches of sheared rhyolite. The rhyolite is traversed by numerous small calcite stringers, which carry a little pyrite and sphalerite. At the northeast face of the same level is a lamprophyre dyke 7 feet wide. It is cut by several vertical fissures, but no veins occur along them. Southeast of the dyke the rhyolite is fissured over a width of 1 foot and contains numerous small veinlets of sphalerite with a little galena and tetrahedrite. This vein zone dips to the south at 60 degrees. On the Compressor level the Ashman lode was stoped to a height of 15 feet for a distance of 20 feet. Where the crosscut from the Henderson lode meets the Ashman lode on this level there is an 8-inch vein consisting of brecciated angular fragments of rhyolite cemented by grey quartz, sphalerite, and arsenopyrite. At the southwest face there is a sheared zone 20 inches wide along the contact of lamprophyre dyke and rhyolite. The dyke is bleached and replaced by carbonate and the sheared rock contains about 1 per cent each of sphalerite, pyrite, and arsenopyrite. At the northeast face there are two fault fissures 6 feet apart dipping 50 degrees southeast, but neither carries any vein matter. From the 500 level a stoped zone 240 feet long extends from 50 to 100 feet upwards along the Ashman vein-lode. Mine assay plans disclose that this part of the vein-lode held high values in silver. Some of the ore remains in the roof of the adit between the ore chutes. Eighty-five feet southwest of the crosscut there are seven parallel fissures within a width of 5 feet. A lamprophyre dyke 3½ feet wide follows along the back with rhyolite to the southeast. Both dyke and rhyolite are sliced, and for 8 to 12 inches along the contact the two rocks are highly fractured and brecciated. The rock fragments are cemented by sphalerite, galena, and tetrahedrite, which constitute up to 75 per cent of the lode matter. They are accompanied by a little quartz, carbonate, and pyrite. The parallel fissures in the lamprophyre contain small stringers and veins of these sulphides ranging from ⅛ inch to 2 inches in width. At the southwest face of the drift (500 level) the fissuring is confined to a lamprophyre dyke 4 feet wide. Calcite stringers occur along three of the fissures, but no sulphides were seen. There is a sheared zone 1 foot wide in rhyolite at the northeast face, but it contains only barren calcite stringers. The Ashman vein on the 600 level was not examined as these workings were flooded.

On the surface, at the northeast end of the combined Henderson-Ashman vein-lodes, are two shallow shafts (*See* Figure 9) 140 feet apart. The No. 1 shaft exposes 2 to 3 feet of fissured and altered dacite flow breccia largely replaced by sphalerite and arsenopyrite with a little galena and tetrahedrite. The lode is not well exposed at the No. 2 shaft, which is full of water, but appears to be about 5 feet wide. On the dump there is a large pile of ore, consisting of altered flow breccia replaced by the same ore minerals as at the No. 1 shaft. Mine assay plans indicate that the ore from these shafts averages about 0·3 ounce of gold a ton, with

much zinc and a little silver and lead. The face of the McPherson adit would have to be advanced a little over 1,200 feet to reach a position about 600 feet vertically below the No. 2 shaft.

The Fault Plane vein-lode has been drifted on for 400 feet on the 300 level, for 620 feet on the 500 level, and for 360 feet on the 600 level. A steeply dipping branch vein from the Fault Plane vein-lode is intersected on the 600 level between the shaft and the 360-foot drift. This vein, known as the "Little Stranger", has been drifted on for 80 feet. There are three stopes on the Fault Plane vein-lode, two above the 500 level and one above the 300 level. Where seen on the 500 level this vein-lode contains from two to seven parallel fissures across widths of from 1 to 3 feet. There is, however, very little brecciation of the rhyolite and tuff beds, and the vein deposits are narrow and few.

A small vein known as the Gerrard is intersected by a crosscut 75 feet north of the Ashman vein on the 500 level. Along a 50-foot drift it averages 3 inches in width and consists of carbonate with a little quartz, arsenopyrite, and sphalerite.

Another vein-lode known as the Gill is exposed in an open-cut at elevation 3,925 feet, 300 feet east of the Thompson portal, where there are five vertical fissures spaced a foot apart with vein fillings from 1 to 3 inches wide occupying the outside fissures. The veins consist of quartz and carbonate with considerable sphalerite and a little arsenopyrite. The continuity of the lode has not yet been determined.

Vein quartz seems to have been deposited throughout the period of mineralization of the Ashman, Henderson, and Fault Plane vein-lodes. Of the metallic minerals, pyrite and arsenopyrite were introduced first and galena, sphalerite, tetrahedrite, ruby silver (pyrargyrite), and chalcopyrite followed. Deposition of carbonate, in the form of calcite and rhodochrosite stringers and veins, in part preceded and in part followed the period of metallic mineralization.

The Dome vein-lode lies 1,300 to 1,400 feet southeast of the Henderson. It strikes north 65 degrees east, dips 75 to 85 degrees northwest, and is well defined for a distance of 700 feet, from the portal of a 200-foot adit at elevation 4,150 feet to elevation 4,350 feet. Below the adit the lode splits into two fissured zones, which continue down the slope at a small angle to each other for a distance of several hundred feet. Southwest of the split the fissures carry occasional small veins, but none of importance was seen. At the adit the vein-lode ranges from 7 feet at the portal to 3 feet in width at the face of the drift. Dacite flow breccia is sheeted by eight parallel fissures at the portal, but several of these join farther within the adit. The fissures contain sulphide veins up to 3 inches wide. The wall-rock is altered and partly replaced by sulphides, and cross fractures contain sulphide stringers. The ore minerals, in order of abundance, are arsenopyrite, sphalerite, pyrite, galena, chalcopyrite, and tetrahedrite. A little vein quartz is associated with these sulphides. Above the adit the rock is strongly fissured over widths ranging from 1 to 6 feet, and one or more sulphide veins ranging from 2 to 10 inches in width may be seen in each of the open-cuts up to an elevation of 4,350 feet. Farther northeast the vein-lode is concealed beneath a flat, grassy meadow. Parts of the Dome lode could supply a fair grade of silver-lead-zinc ore.

King Tut Group (57)

References: Ann. Repts., Minister of Mines, B.C.: 1924, p. 96; 1927, p. 136; 1928, p. 161.

The King Tut prospect is on the southwest slope of Hudson Bay Mountain, 7 miles west of Smithers and ¾ mile south of the Duthie mine. The vein and workings are on the west bank of a small creek about ¼ mile east from the motor road to Smithers. The property was owned by R. L. Gale, but is now open. In 1924, Milligan Brothers sank a 50-foot shaft on the vein and exposed it in several open-cuts. J. J. O'Brien and F. H. Taylor held an option in 1927 and 1928, and explored the vein from the creek level by a 350-foot crosscut and a 65-foot drift.

The claims are underlain by volcanic rocks, and in the vicinity of the workings rhyolite, andesite, tuff, and andesite flow breccia are the predominant types.

A sheared zone ranging from 1 to 4 feet in width has been traced by open-cuts and a 50-foot shaft for about 500 feet between elevations of 3,400 and 3,600 feet. It lies about 225 feet above the bed of a small mountain stream and runs parallel to the stream. The shearing strikes north 65 to 70 degrees east and dips from 70 degrees southeast to 70 degrees northwest. In general the sheared zone is very sparsely mineralized. The sheared rock, in most places rhyolite or andesite, is altered and bleached, but contains only a little pyrite, siderite, and arsenopyrite. On the dump at the shaft a few specimens of altered rhyolite were seen that carry up to 3 per cent sulphides, mostly sphalerite with a little galena and chalcopyrite associated with siderite stringers.

At elevation 3,200 feet a crosscut adit is driven north 24 degrees west for 350 feet from the bed of the mountain stream. The adit passes through 105 feet of tuff breccia and then enters a zone of rhyolite and andesitic flows. The contact of the flows and tuff breccia strikes north 40 degrees east and dips 35 degrees southeast. The sheared zone is intersected at 310 feet from the portal and is followed by a 65-foot drift to the northeast. It ranges from 1 to 2 feet wide in the drift and is very sparsely mineralized. In places it carries 1 or 2 per cent of arsenopyrite. A 12-inch channel sample taken across this vein at the intersection of the crosscut and drift assayed: gold, a trace; silver, 0·32 ounce a ton.

DESCRIPTIONS OF COAL DEPOSITS

Kispiox Coal Area[1] (3)

References: Geol. Surv., Canada, Sum. Repts.: 1909, p. 67; 1912, p. 89; Mem. 69, pp. 163-167.

Coal seams and carbonaceous shales occur at many places along Skeena and Kispiox Rivers from their junction to 7 miles above. This area is underlain by greywacke, shale, and conglomerate. Fossil plants collected from the coal-bearing beds show a range in age from Kootenay to Blairmore. The strata are highly disturbed, faulting and overturning

[1] Examined by J. E. Armstrong.

being the rule rather than the exception. Numerous dykes and sills of granodiorite and porphyritic granodiorite intrude the sediments.

A 3-foot coal seam is exposed on the western bank of Kispiox River 5½ miles above the junction. This seam occurs on the north limb of a faulted anticline. On the eastern bank of the Kispiox about ¼ mile farther upstream another coal seam, with a maximum width of 3 feet, is exposed. The coal in both seams is very impure and crushed. Local inhabitants have used coal from these seams in their forges.

Three, small, dirty, and crushed coal seams were observed along the west bank of Skeena River between Kispiox village and a point approximately 5 miles north. At this point two seams are exposed. Normally they are 6 to 12 inches wide, but due to faulting and folding they form pockets that are much wider. In an open-cut 15 feet above the river, one seam has been squeezed at its junction with a fault so that now the coal forms a pocket 4 feet in width and 20 feet in length along the fault plane. In a second pit, 50 feet higher, the second seam is exposed. It has migrated under pressure to the crest of a small anticline where it forms a body 20 feet long, 10 feet wide, and at least 6 feet thick. The local inhabitants use the coal from these two seams in their forges. A representative sample of coal collected from the pit 15 feet above the river and analysed by the Fuel Testing Laboratories at Ottawa, gave the following analysis:

	As received Per cent
Moisture	7·6
Ash	30·9
Volatile matter	19·0
Fixed carbon	42·5

Seven miles above the junction of Skeena and Kispiox Rivers, on the west bank of the Skeena, a slide has laid bare a face of rock 300 feet high. The sedimentary section exposed on this face is broken by a fault. The thickness of the section below the fault is approximately 400 feet and above approximately 600 feet. The lower 400 feet of the series contains three coal seams, 1·9, 0·6, and 1·3 feet thick, respectively, and the upper 600 feet of the series contains four seams 1·4, 0·9, 0·6, and 1·3 feet thick, respectively. According to Malloch[1], three samples of coal from these seams gave the following analyses:

	——	Moisture	Volatile matter	Fixed carbon	Ash
		Per cent	Per cent	Per cent	Per cent
1	1·9-foot seam below the fault	1·07	20·43	51·26	27·24
2	0·6- and 1·3-foot seams below the fault	1·19	10·33	64·77	23·71
3	1·4-, 0·9-, and 0·6-foot seams above the fault	2·10	11·32	68·34	18·24

[1] Geol. Surv., Canada, Sum. Rept. 1912, p. 101.

Three coal seams are exposed on the east bank of Skeena River 2 to 3 miles above the mouth of Shegunia River. The writer did not examine these seams, but according to Leach[1] they are, respectively, 2, 2·1, and 5·1 feet thick. Analyses of the two largest seams gave the following results:

——	Moisture	Volatile matter	Fixed carbon	Ash
	Per cent	Per cent	Per cent	Per cent
2·1-foot seam	1·42	18·76	58·20	21·62
5·1-foot seam	1·18	20·63	57·27	20·92

Seaton Coal Area[2] (40)

References: Ann. Repts., Minister of Mines, B.C.: 1916, pp. 121-122; 1921, pp. 161-162. Geol. Surv., Canada: Sum. Rept. 1910, pp. 99-100; Mem. 69, pp. 179-181.

Outcropping along Bulkley River near Seaton (a flag station on the Canadian National Railway 20 miles southeast of Hazelton) is a series of gently dipping sediments containing Upper Cretaceous or Tertiary plant remains. These sediments consist of greywacke, shale, and conglomerate, and contain seams of bituminous coal. They strike northwest and dip 30 degrees to the northeast.

This coalfield was developed by the Wright Coal Company in 1916 and the Bulkley Valley Coal Mines Syndicate in 1927. Since 1927 there has been no development work.

The seams that have been developed all occur on the west bank of Bulkley River. The main seam, known as No. 1, occurs about 400 yards south of Seaton. It was opened up by a 275-foot drift from the river level and a 30-foot inclined shaft sunk from a point above the drift. The shaft breaks through into the drift 100 feet from the portal. As the workings are now caved the writer was unable to examine this seam. It is reported to be 4½ feet wide, split by bands of shale. Lay[3] gives the following analysis on a sample from this seam:

	As received Per cent
Moisture	1·8
Volatile matter	17·7
Fixed carbon	36·7
Ash	43·8

Four hundred yards downstream another seam (No. 2) is exposed. It is 17 inches wide, and a drift follows it for 15 feet. According to Lay[4], a sample of clean coal gave the following analysis:

	As received Per cent
Moisture	3
Volatile matter	21·2
Fixed carbon	59·0
Ash	16·0

[1] Geol. Surv., Canada, Sum. Rept. 1909, p. 67.
[2] Examined by J. E. Armstrong.
[3] Ann. Rept., Minister of Mines, B.C., 1927, p. 161.
[4] Op. cit., p. 161.

Along a third seam (No. 3), 3 feet in width, a drift was run 70 feet. Lay[1] gives the following analysis of a sample from this seam:

	As received Per cent
Moisture	1·4
Volatile matter	19·5
Fixed carbon	43·4
Ash	35·7

Several other seams have been found in the area, but have not been developed.

As the seams are small, and as they contain such a high percentage of ash as to necessitate washing before marketing, the commercial value of this area is problematical.

Lake Kathlyn Coal Mine (51)

References: Ann. Repts., Minister of Mines, B.C.: 1917, p. 125; 1926, p. 161; 1932, p. 90; 1933, p. 113; 1934, p. G32; 1935, p. G27; 1936, p. G43. Geol. Surv., Canada, Sum. Rept. 1925, pt. A, p. 119.

The Lake Kathlyn coal mine (*See* Figure 11) is 5 miles northwest of Smithers on the southeast side of Glacier Gulch. The property is 2½ miles by good road west from Lake Kathlyn railway station. In 1917 the property was reported to consist of ten coal leases owned by Frank X. Frank of Smithers. In 1926, British Columbia Anthracite, Limited, leased the prospect and explored two coal seams by short adit drifts. Lake Kathlyn Anthracite Coal Company, Limited, carried on exploration work in 1932 and 1933 by driving a main crosscut adit over 400 feet. Between 1934 and 1936, intermittent work was carried on by Northwest Anthracite Syndicate, headed by Thomas Campbell. A small tonnage of coal was mined and marketed locally.

The coal seams occur in a series of sedimentary rocks consisting of black, carbonaceous shales, carbonaceous sandstones, argillites, greywacke, and sandstones, with one or more beds of pebble conglomerate above the coal horizons. The sediments have all been hardened, the sandstones, in particular, being indurated almost to quartzite. Surface exposures of these rocks have a characteristic light rusty coloration through oxidation of a small content of finely disseminated sulphide. Some of the shaly beds are distinguished by the occurrence of occasional round or oval-shaped ironstone nodules averaging 1 inch in diameter. Ripple-marked strata are not uncommon. The sediments strike from south 45 to south 60 degrees east and dip from 50 to 60 degrees northeast.

Fossil plants were seen in several argillaceous beds close to the coal seams, and a few poorly preserved fossil shells were picked up on the talus slope above the main adit. The plants collected were identified by W. A. Bell as follows:

Cladophlebis virginiensis (Fontaine)
Pityophyllum graminaefolium (Knowlton)
Podozamites lanceolatus (Lindley and Hutton)
Ginkgoites pluripartita (Schimper)

[1] Op cit., p. 162.

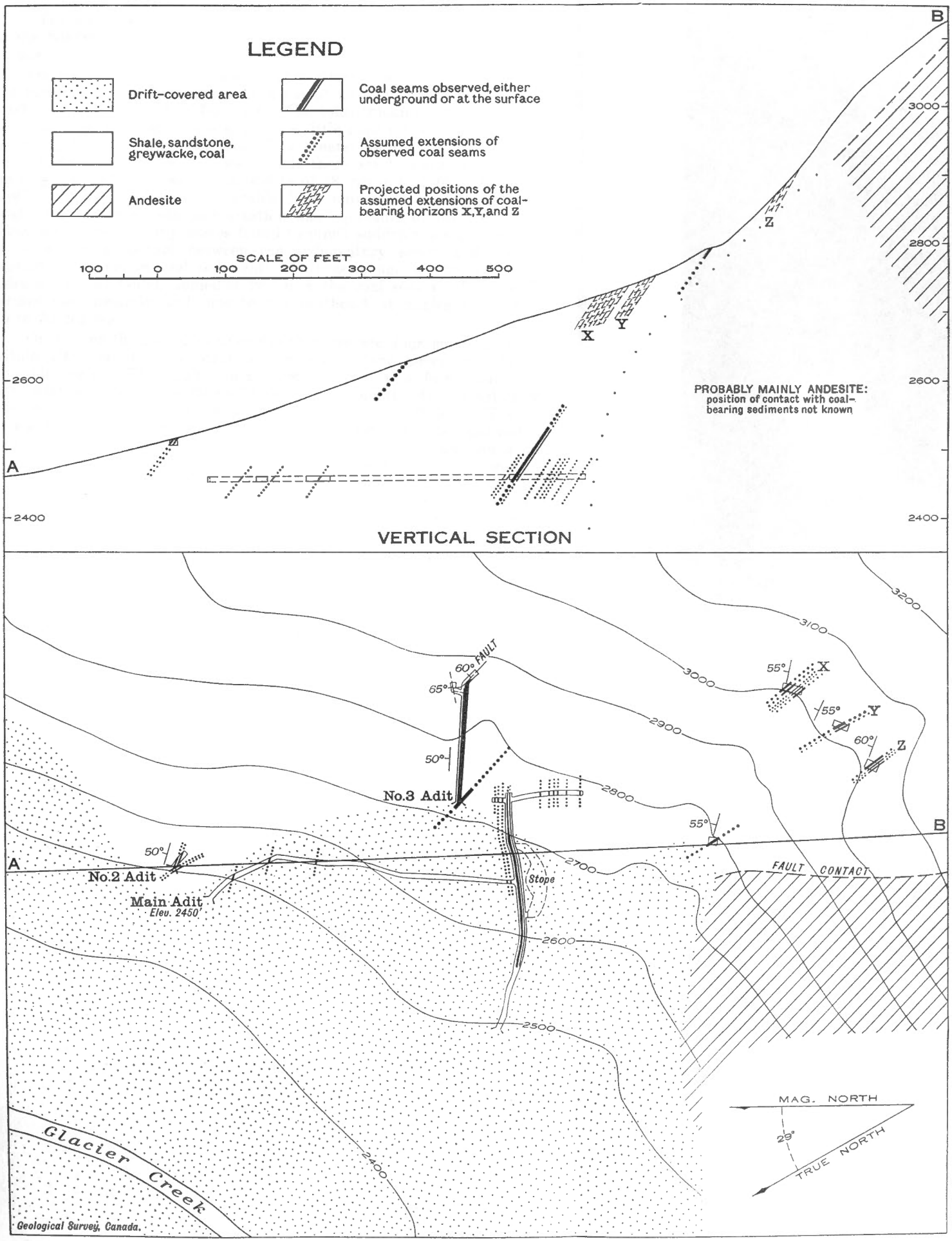
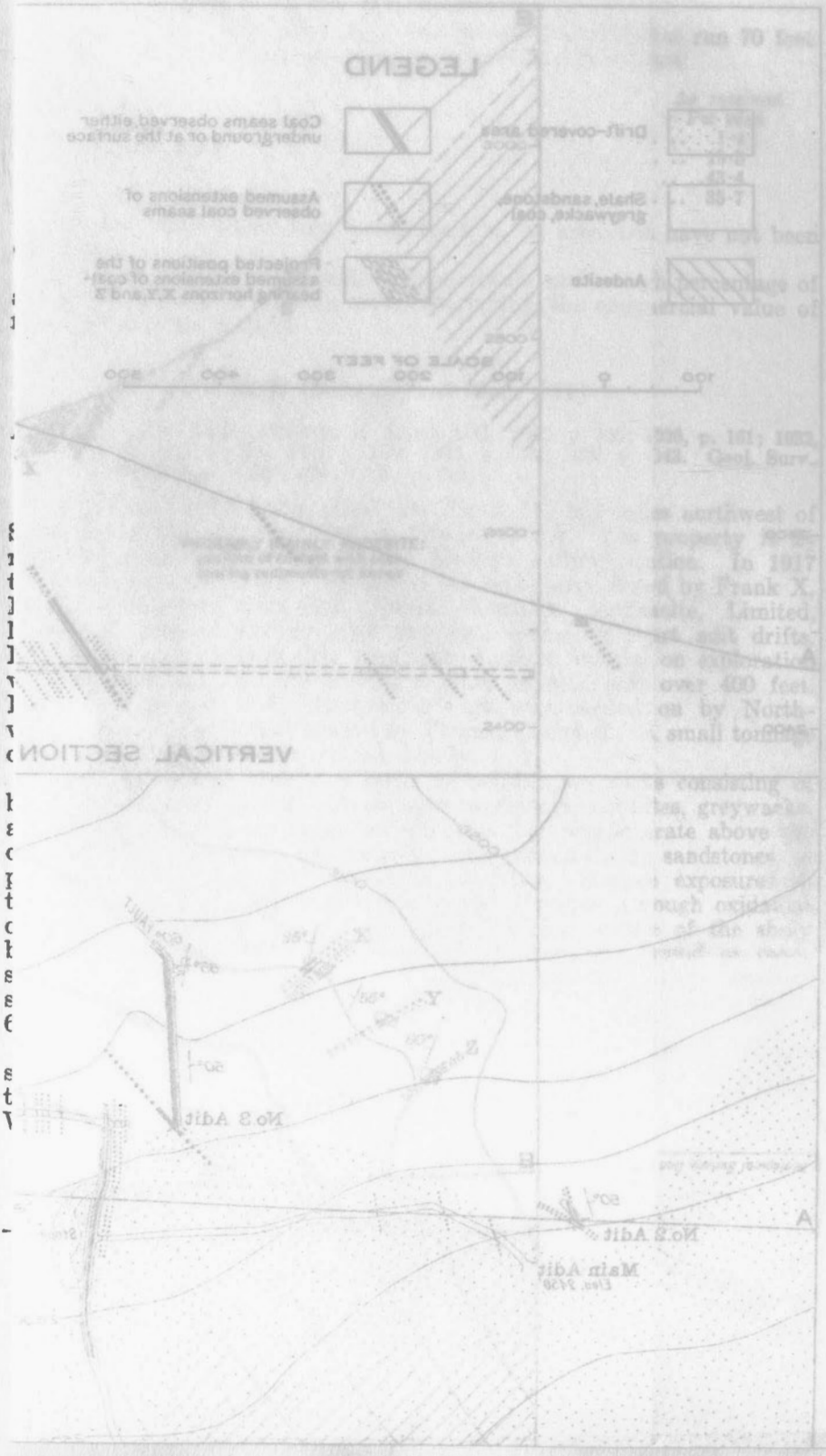


Figure 11. Plan and vertical section at Lake Kathlyn coal mine.



"The above assemblage although small is made up of species common in the Kootenay of Alberta, and the beds are considered to be equivalent in age."

On the south side of Glacier Gulch development work has disclosed the presence of about twenty coal seams at irregular intervals throughout a 600-foot column of stratified rock. The total thickness of the formation as exposed on this side of the gulch is a little over 1,000 feet, and the coal is confined to the lower 600 feet. The greater number of the coal seams range from 6 to 12 inches in width, but there are two seams with widths up to 4 feet and two others with widths of 18 inches and 24 inches, respectively. There has been considerable fault movement along many of the coal beds with resultant pulverization and squeezing of the coal, so that these seams are in many places found to pinch suddenly along their strike. A strong fault contact between the sedimentary series and the older underlying volcanics and sediments of Jurassic age is exposed on both sides of Glacier Gulch immediately below the coal seams. The fault line strikes northwesterly and dips to the northeast at angles varying from 45 to 70 degrees.

On the north side of Glacier Gulch there are four small coal seams within 100 feet of the contact of the sedimentary series and the older volcanic rocks. The fault contact between the two formations strikes northwest and dips from 60 to 70 degrees northeast. It is marked by a narrow ravine with walls rising steeply for 50 to 100 feet. The hard, volcanic rocks along the foot-wall side are slickensided and grooved with fault striæ. At elevation 2,950 feet a 25-foot shaft is sunk on a small silver-lead-zinc vein 20 feet southwest of the contact in the volcanics. Opposite the shaft and 20 feet northeast of the fault contact there is a 12-inch and an 8-inch coal seam separated by 16 inches of shale. A 12-inch and a 24-inch coal seam outcrop on a steep slope 60 and 100 feet, respectively, farther east. These coal seams have not been prospected.

On the south side of Glacier Gulch (*See* Figure 11) the main adit at elevation 2,450 feet is driven south as a crosscut for 475 feet to a drift on two coal seams. In the roof of the drift at the crosscut, a 28-inch coal seam is separated from a 9-inch coal seam by 27 inches of carbonaceous sandstone. The larger seam is sheared and thins eastward along its strike. At the face of the east drift, 135 feet easterly from the main crosscut, the larger seam has thinned out to 8 inches of soft, dirty coal with 8 inches of sandstone separating it from the parallel seam, which consists of 6 inches of soft, sheared coal. The drift to the west follows these two seams for 133 feet and then passes through 90 feet of loose slide rock to emerge as an air adit at the surface, 20 feet above the adit level. At 85 feet west along the drift from the crosscut the main seam is 17 inches thick, and 15 inches of shale separates it from the parallel seam, which is 12 inches thick. A small amount of stoping has been done on these two seams above the end of the main crosscut. In the main raise 30 feet above the drift level, the larger seam is 4 feet wide and the parallel seam 10 inches wide, with 30 inches of shale between them. The 10-inch seam consists of firm, dull black coal, whereas the larger seam is a soft, dirty, sheared coal.

Channel samples 112 and 113, collected by the writer across these two seams, were analysed by the Fuel Testing Laboratories at Ottawa and gave the following results:

	No. 112 10-inch seam As received	No. 113 4-foot seam As received
	Per cent	Per cent
Moisture	16·6	14·0
Ash	9·5	15·7
Volatile matter	4·1	5·4
Fixed carbon	69·8	64·9
Sulphur	0·1	.....
B.T.U. per lb. gross	10,200	.....

About 60 feet above the drift level the raise follows the main seam, but does not break through to the smaller, parallel seam. The main seam is 40 inches wide there and consists of highly pulverized, soft, sheared coal with glistening, slickensided, intersection surfaces throughout its mass. This coal crumbles and soils the fingers readily on handling. It is probable that this part of the seam has been thickened through flowage under pressure. A channel sample (No. 111) taken by the writer across this part of the seam and analysed by the Fuel Testing Division at Ottawa gave:

	As received Per cent
Moisture	14·9
Ash	28·1
Volatile matter	5·6
Fixed carbon	51·4

From the end of the east drift, a crosscut extends 110 feet south and intersects six other coal seams at distances of 45, 56, 63, 68, 80, and 105 feet, respectively, south of the drift (*See* Figure 11). These coal seams are all less than a foot thick. The beds strike southeast and dip 60 degrees northeast. There has been a little movement along each seam, judging by the somewhat sheared nature of the coal. Three other very similar coal seams, each about 6 inches wide, are intersected at 5-foot intervals in a 20-foot crosscut to the north from the end of the east drift. In the main crosscut 10 feet north of the drift there is a 12-inch coal seam of the soft, crushed type, criss-crossed by innumerable, shiny, slickensided surfaces. A parallel, 9-inch seam of comparatively firm, clean coal lies 20 inches farther north. Three other coal seams are intersected by the main crosscut at distances of 45 feet, 105 feet, and 175 feet, respectively, south from the portal. These seams are less than 6 inches wide, and there has been some crushing along each one. The seam at 175 feet from the portal appears to be the downward continuation of the seam explored in the No. 3 or upper adit (*See* Figure 11).

No. 2 adit is 75 feet northeast of the portal of the main adit and 40 feet higher. It is driven 33 feet along two coal seams, each of which is from 6 to 7 inches in width and is separated from the other by 1 foot of carbonaceous shale. The coal is clean and black and is very little disturbed.

No. 3 adit (*See* Figure 11) is at elevation 2,700 feet, its portal being 400 feet south of the portal of the main adit and 250 feet higher. It is 203 feet long, with a 25-foot crosscut to the northeast 40 feet from the face. For the first 180 feet from the portal, the drift follows a coal seam that ranges from 3 to 4 feet in width. At 180 feet from the portal a fault crosses the coal seam at a small angle. The coal is squeezed out along the fault and its easterly extension has not been located. The coal seam exposed along the roof of the adit has suffered only minor crushing. It varies from glistening black to dull graphitic black and is comparatively firm and clean, with only minor slickensided cross fractures. The following analyses of this coal are of channel samples taken across the roof of the adit by the writer and analysed by the Fuel Testing Division at Ottawa. Sample No. 109 was taken 18 feet from the portal across 46 inches of coal. Sample No. 110 was collected 155 feet from the portal where the seam measured 37 inches, but included two beds of bone, 2 and 3 inches thick, respectively, which were excluded from the sample.

	No. 109 46 inches As received	No. 110 32 inches As received
	Per cent	Per cent
Moisture	13·7	14·9
Ash	20·0	15·9
Volatile matter	3·1	3·2
Fixed carbon	63·2	66·0
Sulphur	.....	0·1
B.T.U. per lb. gross	9,100	9,790

At elevation 3,000 feet, and roughly 500 feet south of No. 3 adit, three groups of coal seams are exposed by a number of open-cuts (*See* Figure 11). The first group consists of five seams, which form part of a section, from north to south, as follows: 30 inches coal, 18 inches rock, 12 inches coal, 6 feet rock, 6 inches coal, 18 inches rock, 6 inches coal, 4 inches rock, and 24 inches coal. These seams strike south 45 degrees east and dip 55 degrees northeast. The 30-inch seam may be the upward continuation of the large coal seam in the main adit drift.

In open-cuts 75 feet farther south an 18-inch and a 12-inch coal seam, with 10 inches of intervening shale, are exposed. Carbonaceous shale immediately below the 12-inch seam is matted with stems and other plant remains. The 12-inch coal seam has undergone very little crushing and is comparatively clean and hard. A channel sample, No. 114, taken across it was analysed by the Fuel Testing Division at Ottawa, and has the following composition:

	As received Per cent
Moisture	14·8
Ash	14·5
Volatile matter	7·1
Fixed carbon	63·6
Sulphur	0·1
B.T.U. per lb. gross	9,500

The third group of coal seams is exposed in a cut 60 feet farther east. Here is a 12-inch seam of firm, clean coal with several, parallel, 3-inch seams over a width of 4 feet. These outcrops are only a short distance from the fault contact of the coal-bearing sediments with the older underlying volcanic and sedimentary rocks (*See* Figure 11). The upward extensions of these groups of coal seams were seen to outcrop for several hundred feet farther up the precipitous slope.

The coal on this property is soft and soils the fingers, and has a roughly cubical fracture where it is not sheared. Its low content of volatile matter is typical of anthracitic coal, but it has passed beyond the anthracite stage and falls into that class of coal known as super-anthracite, whose heating value is lower than that of anthracite.

DESCRIPTIONS OF MARL DEPOSITS

Robinson Lake Marl (16)

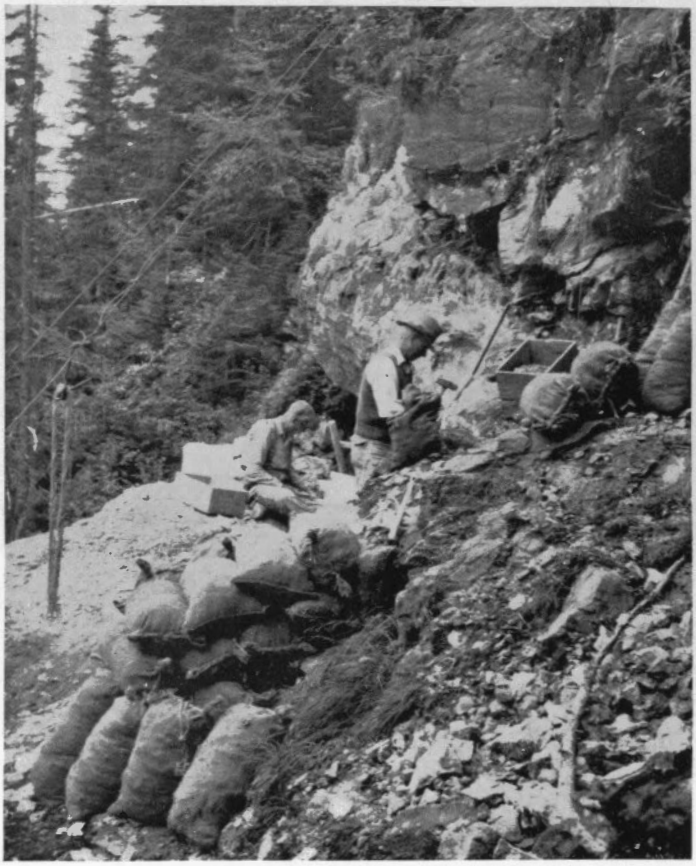
Robinson Lake is 6 miles northeast of Hazelton, a few hundred feet from the Nine Mile Mountain road. The lake is 1,900 feet long from north to south with an average width of 400 feet and a maximum width of 900 feet. It is a clear water lake, in few places over 5 feet deep except in the centre where there is 30 feet of water. Everywhere in shallow water the lake bottom consists of a thick deposit of soft white to grey marl. The marl is concealed in many places by a heavy growth of Chara, a plant in which lime is deposited in the cells and cell walls. These plants have evidently contributed largely to the deposition of the marl, but some shell remains were also observed. At the north end of the lake an inflowing stream flowing through low, marshy land has supplied dark vegetable matter, which is deposited locally with the marl. The best quality of white marl is found at the south, or outlet, end of the lake. Here a 12-foot pole pushed down into the deposit does not reach the bottom of it. Elsewhere the calcium carbonate layer is at least 6 feet thick, as a pole thrust into it pushes down that far before striking any resistance and comes up white covered.

The marl is of economic importance because of its value as a land dressing. It could be readily mined from the lake bottom by using a suction pump or small dredge.

PLATE II

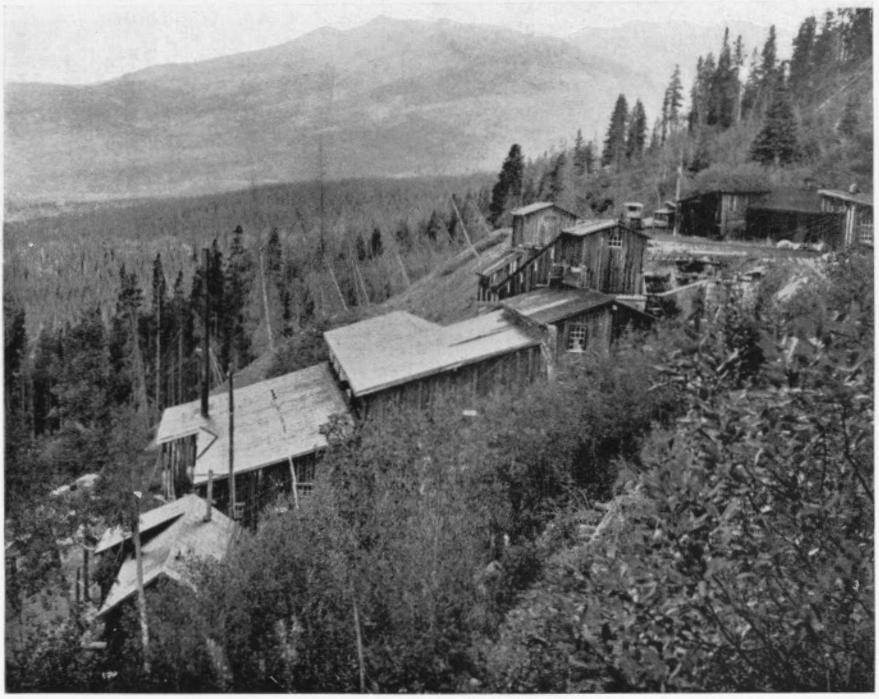
Ore shoot on the No. 1 vein, Silver Standard mine; the width of the shoot is indicated by the distance between the two hammers.

PLATE III



Bagging high-grade gold ore on the Glacier Gulch Gold group.

PLATE IV



Flotation mill at Duthie mine.

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