N.T.S. 82

BRITISH COLUMBIA DEPARTMENT OF MINES
Hon. W. J. ASSELSTINE, *Minister*   JOHN F. WALKER, *Deputy Minister*

BULLETIN No. 7

Lode-Gold Deposits

Upper Lemon Creek Area

and

Lyle Creek-Whitewater Creek Area

Kootenay District

by

R. J. MACONACHIE

1940

THE GOVERNMENT OF THE PROVINCE OF BRITISH COLUMBIA

VICTORIA, B.C.:
Photo-offset by CHARLES F. BANFIELD, Printer to the King's Most Excellent Majesty.
1940.

BRITISH COLUMBIA DEPARTMENT OF MINES
Hon. W. J. ASSELSTINE, *Minister* JOHN F. WALKER, *Deputy Minister*

BULLETIN No. 7

Lode-Gold Deposits

Upper Lemon Creek Area

and

Lyle Creek-Whitewater Creek Area

Kootenay District

by

R. J. MACONACHIE

1940

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA

VICTORIA, B.C.:
Photo-offset by CHARLES F. BANFIELD, Printer to the King's Most Excellent Majesty.
1940.

Looking north-west towards head of Whitewater Basin.

Mountains, glacier and moraine at the northern end of
Whitewater Basin.

Whitewater Basin from south-east end.

Upper Whitewater Basin.

CONTENTS.

UPPER LEMON CREEK AREA.

Introduction

Field work in the area adjacent to the headwaters of Lemon Creek, undertaken during the 1939 season, was complementary to similar work completed on the lower reaches of the creek during the previous year. Similar conditions prevail generally throughout these two entirely arbitrary subdivisions and reference to the Annual Report, Minister of Mines, British Columbia, 1938, which contains data on conditions farther down the creek, will probably be of assistance and permit a broader conception of the region as a whole. The sketch-map which accompanied the 1938 Report (Fig. 1) together with Fig. 2, which accompanies this Report, cover Lemon Creek for its entire length. Lemon Creek joins the Slocan River about 6 miles south from Slocan City.

The headwaters of Lemon Creek are accessible from the Trans-provincial Highway, at a point 5 miles easterly from Nelson. From the highway 7 1/2 miles of poor, but passable, road leads to the southerly end of Six Mile Lakes. Thence a pack-trail on good grade follows the east margin of the lakes and, in 3 1/2 miles, reaches Lemon Creek at Oro. The trail follows Lemon Creek up-stream, north-easterly, on good grade for 3 1/2 miles above Oro; at slightly over 2 miles above Oro a branch-trail leads off to the east, up Crazy Jane Creek, to the Oro Fino group. At 3 1/2 miles above Oro a second branch-trail leads northerly to the Barnett group. Above the Barnett branch-trail the main Lemon Creek trail continues for slightly over 1 1/2 miles to the Hudson Bay group, shown on Fig. 2 as the Nansen and Fram mineral claims. This 1 1/2 miles of trail is steeper than the lower sections and in poorer condition, owing partly to the fact that it rises above timber-line and receives considerably less protection from snow-slides and other erosive agents. For its entire length the main trail is passable for foot-traffic at the present time; as far as the Barnett turn-off it is barely adequate for horse-packing; above this point several small bridges and minor repairs will be necessary to permit the use of horses.

In the region topographic relief is marked owing to the depth of the stream-valleys which are deeply-incised, steeply-walled, straight, and the most noticeable topographic features below timber-line. Above timber-line, at approximately 6,000 feet in elevation, the smaller flow of water, the more intense effects of rock-disintegration, and the lack of protective growth combine to produce less defined drainage-systems. At the divides, between two or more main drainage-areas, large

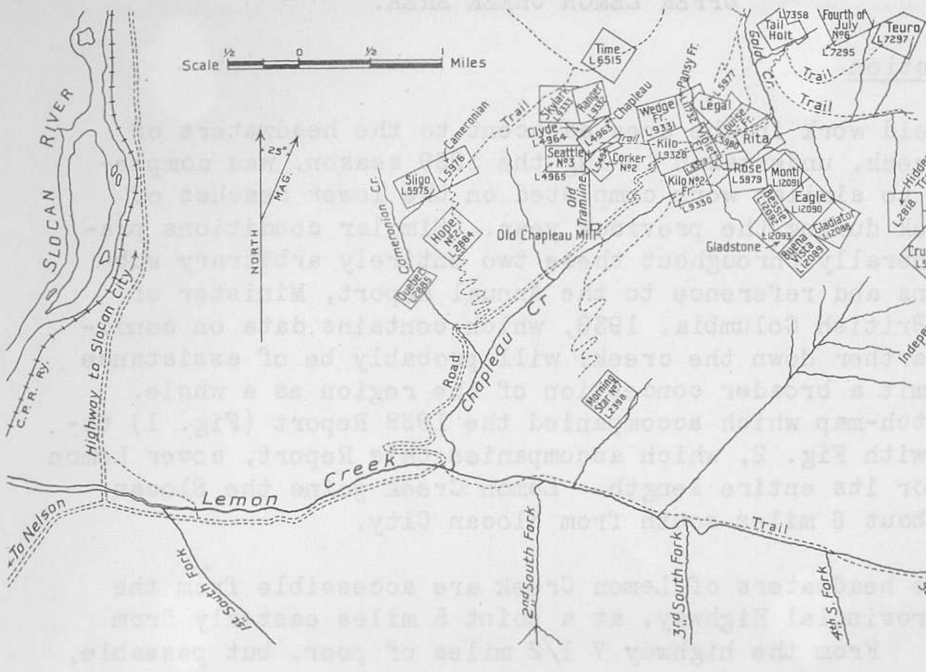

Fig. 1. Chapleau Creek - Lemon Creek Area.

basins filled with glacial debris indicate the recent presence of ice. In the district under consideration there is no permanent ice but slightly to the east of the map-limit there is a considerable amount on the higher peaks.

As usual in this section of the province, elevations which range between 4,000 and 8,000 feet are responsible for climatic conditions which permit only a short season for surface work, and easy, economical transportation. Snowfall is heavy, slides are obstructive and dangerous, spring-thaws make travel almost impossible; and the net result is, that under the present conditions of access, mining operations must necessarily be self-sufficient in heavy supplies from November until May or June.

Timber is plentiful up to elevations of 5,000 feet. Lemon Creek is of sufficient flow for any milling operation which may be expected in the district, but it is doubtful if more than a small amount of power could be developed economically.

Geological conditions in the district are broadly uniform. The rocks are members of the Nelson batholith and their exposures represent phases of the intrusive which vary from

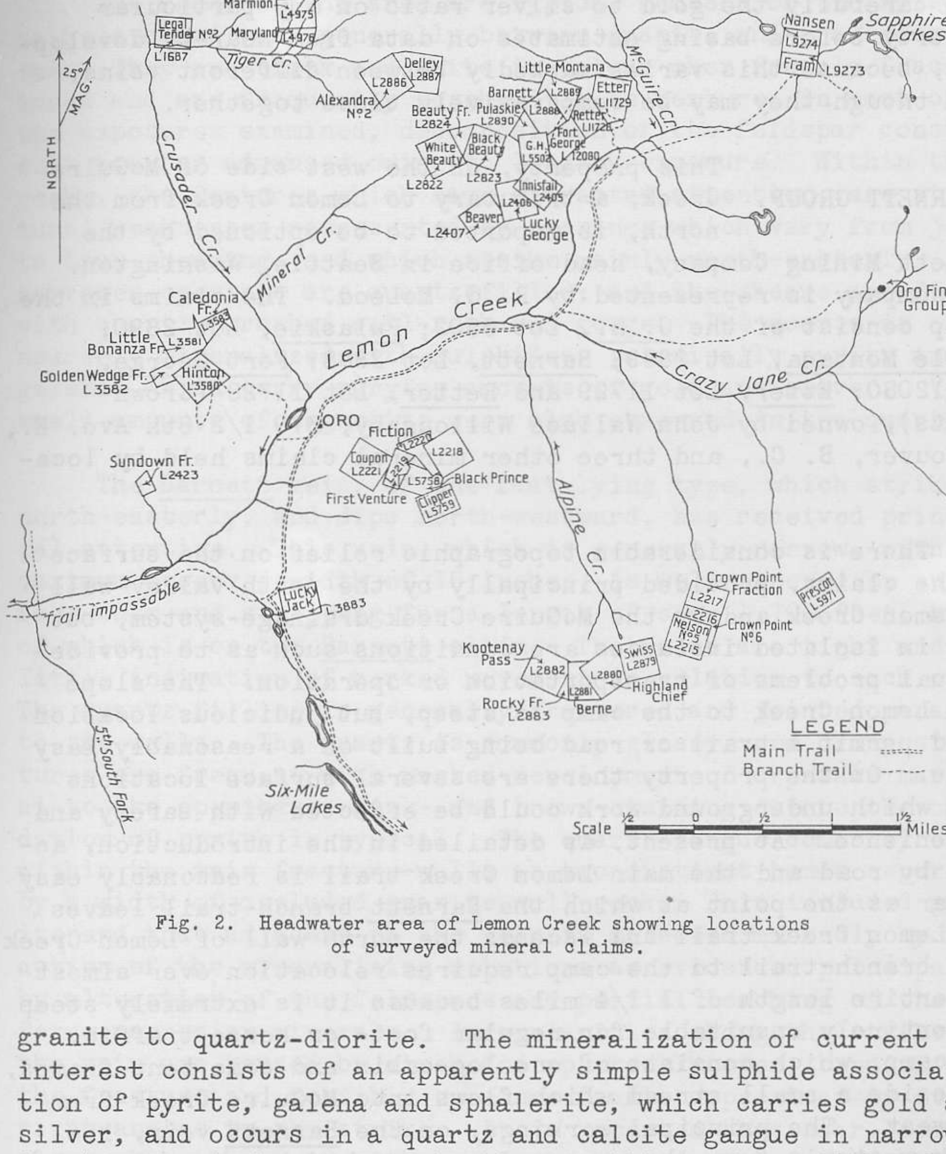

Fig. 2. Headwater area of Lemon Creek showing locations of surveyed mineral claims.

granite to quartz-diorite. The mineralization of current interest consists of an apparently simple sulphide association of pyrite, galena and sphalerite, which carries gold and silver, and occurs in a quartz and calcite gangue in narrow fractures and shear-zones in the granitic rocks. Although none were identified in the specimens examined microscopically, it is probable that the ordinary silver-bearing sulphides and sulpho-salts are present in the veins where the silver to gold ratio is high. By the evidence of the occurrences examined, these veins and shears have a general north-easterly strike and dip from flatly north-westward to steeply north-eastward.

At the present time there is little activity in the district although in years past there has been considerable preliminary development on some of the properties.

Persons unacquainted with the area are advised to ascertain carefully the gold to silver ratio on any particular property before basing estimates on data from near-by development, because this varies markedly between different veins, even though they may be comparatively close together.

BARNETT GROUP. This property, on the west side of McGuire Creek, a tributary to Lemon Creek from the north, is reported to be optioned by the Barnett Mining Company, head office in Seattle, Washington. The company is represented by R. G. McLeod. The claims in the group consist of the G. H., Lot 5502; Pulaskie, Lot 2890; Little Montana, Lot 2889; Barnett, Lot 2888; Fort George, Lot 12080; Etter, Lot 11729 and Retter, Lot 11728 (Crown-grants), owned by John Wallace Willoughby, 379 1/2 8th Ave. E., Vancouver, B. C., and three other mineral claims held by location.

There is considerable topographic relief on the surface of the claims, provided principally by the north valley-wall of Lemon Creek and by the McGuire Creek drainage-system, but only in isolated instances are conditions such as to provide unusual problems of transportation or operation. The slope from Lemon Creek to the camp is steep, but judicious location would permit a trail or road being built on a reasonably easy grade. On the property there are several surface locations from which underground work could be effected with safety and convenience. At present, as detailed in the introduction, access by road and the main Lemon Creek trail is reasonably easy as far as the point at which the Barnett branch-trail leaves the Lemon Creek trail and ascends the north wall of Lemon Creek. This branch-trail to the camp requires relocation over almost its entire length of 1 1/4 miles because it is extremely steep and entirely unsuitable for regular foot- or horse-traffic. The camp, which consists of one log-cabin and some tent-frames, is beside a small stream which flows into McGuire Creek from the west. The principal workings, on the Barnett vein, lie south-westerly from the camp and are reached by approximately a thousand feet of rough foot-trail which rises some 300 feet to an elevation of 6,200 feet at the north-easterly end of the workings. The stream at the camp provides domestic water, reportedly the year-round, but any larger supply could be taken only from Lemon Creek. Timber for all domestic and mining needs is available at or near the camp-site. In any projected expansion of development it would be necessary to give careful consideration to the local occurrence of snow-slides and their effect on planned systems of transportation and operation.

General Geology

The rocks of the area are typical members of the Nelson batholith and vary generally between granite and granodiorite. They are black and white in colour when freshly-fractured and are frequently porphyritic in texture; in most of the exposures examined, decomposition of the feldspar constituents was far advanced owing to lengthy exposure. Within these rocks, the features which have attracted attention, are structural weaknesses represented by openings which vary from joints to true shearing, and which strike mainly north-easterly. The narrower openings are quartz-filled; and the shears are filled with quartz, crushed wall-rock and gouge. The quartz is sparsely mineralized with sulphides, principally pyrite and galena, which carry varying amounts of gold and silver. Very small amounts of magnetite were also observed in the quartz.

The Barnett vein, of the flat-lying type, which strikes north-easterly, and dips north-westward, has received principal attention. This vein, which is generally narrow, with a maximum observed width of 18 inches, is well exposed by surface-cuts and stripping for a length of some 1,700 feet, much of which is on the Barnett claim. The walls are tight and give little indication of marked movement in relation to each other. The quartz-filling is generally fractured and jointed parallel to the walls. The quartz is commonly glassy, and drusy structures are frequent with marked development of crystals marginal to the openings. Pink- and brown-staining due to the oxidation of pyrite is typical. The quartz-gangue commonly occurs within the main fracture-walls as two distinct bands separated by a width of included granite wall-rock. This included granite and that adjacent to the vein is affected markedly by the action of the mineralizing solutions as evidenced principally by alteration of the feldspars and partial leaching of the ferro-magnesian minerals. Irregularities along the strike of the vein are caused by minor and apparently open, bending of the fracture and possibly by minor faults approximately at right-angles to the strike. It is reported that near locations where there is either actual or suggested faulting the vein narrows and values increase. If such conditions are firmly established by further development it may be found that at these locations faulting represents late relief of accumulated strains which are evidenced locally by fractures and joints that provided relatively easy access for final, richer mineralizing solutions. Apart from joints or fractures upon which there may have been such dislocation, and distinct from the vein-fracture itself, there is a third joint and fracture-system which strikes parallel to the vein but dips more steeply to the north-west. This type of fracture is exposed in many places close to the vein on its hanging-wall.

The apparently incompatible association of glassy quartz, magnetite and drusy structures within the vein may possibly be explained by assuming that the mineralization of the fracture took place while the granitic host-rock still retained a considerable part of its heat, and subsequent slow cooling of both host-rock and fracture-filling. A possible alternative explanation is the assumed proximity of the vein to the source of mineralization, and, a long continued deposition from essentially weak solutions, which resulted in maintaining relatively high temperatures in the immediate wall of the fracture and permitted crystallization within the vein. Both suggestions are based upon the questionably diagnostic value of the glassy quartz and magnetite as representative of conditions of relatively high temperature.

In addition to the Barnett vein, two or three shear-zones have been developed on the property. At the present time, it is not absolutely clear whether or not correlation can be made along the strike of two of the three exposures of this type, hence, the doubt as to whether there are two or three separate occurrences. As developed, these are true shears which strike north 50 to 70 degrees east, and dip generally 60 to 80 degrees south-eastward. The dip is variable owing to rolling of the shear, and locally such irregularity may be developed sufficiently to produce dips to the north-west. Movement between the two granite-walls is marked. The maximum width observed between the shear-walls was 40 inches within which there are usually one or more defined quartz veins of a maximum observed width of 22 inches. The remainder of the filling between the shear-walls is composed of gouge and crushed, decomposed wall-rock. Noticeable amounts of calcite are associated with the quartz. Sulphide mineralization is generally sparse but there appears to be a greater concentration of galena in the defined quartz than in the Barnett vein. Wall-rock alteration extends for a foot on either side of the shears and in some cases this is so marked that the operators define certain lengths on the footwall-side as a dyke. In these widths narrow, irregular and barren quartz stringers occur.

Development

For several years the property has lain idle. During 1939 a crew, of up to seven men, has been engaged in cleaning out old workings and in extensive surface-stripping on the Barnett vein. Little new information has been gained from any of the work in the old adits because none of the faces have been advanced, but the stripping, which was done thoroughly and well, has proved excellent continuity of the Barnett vein on the surface. Three adits have been driven on this vein in the past, but at least two of these are now in too poor condition to be of any use owing to the sloughing of the granite in the roof. Ore is reported to have been shipped from one of these workings, driven just below the vein.

Apart from this development on the Barnett vein three other adits expose the conditions of shearing described previously.

In the following descriptions, directions and distances are accurate only within the limits of compass and pace measurement.

Barnett Vein

At the westerly end of the stripping on the Barnett vein, in cut No. 1, elevation 6105 feet, the strike of the vein is due north and the dip 17 degrees west. This cut has been made in a small irregularity within the vein and the strike is local only. This vein is 8 inches wide and is composed of quartz-gangue mineralized very slightly with pyrite. On the footwall-side a 1-inch heavily-rusted streak probably carries the greater part of any values obtained from this location. A sample of this assayed: Gold, trace; silver, 0.6 oz. per ton.

At cut No. 2, elevation 6,115 feet, approximately 235 feet due east from cut No. 1, the vein consists of 11 inches of white quartz, slightly mineralized originally with well-crystallized pyrite, most of which is now leached out.

Cut No. 3, at elevation 6,103 feet, is 40 feet from cut No. 2 on a bearing north 15 degrees east. In this cut the vein strikes north 55 degrees east, dips 23 degrees northwestward, and exemplifies another local irregularity. A sample across 17 inches included: 7 inches of decomposed granite, very slightly silicified, from the hangingwall-side of the vein; 3 inches of quartz immediately below this: 3 inches of decomposed granite, and 4 inches of quartz very slightly mineralized with pyrite on the foot-wall. This sample assayed: Gold, 0.04 oz. per ton; silver, 1.0 oz. per ton.

At cut No. 4, elevation 6,103 feet, 120 feet north 15 degrees east from cut No. 3, the vein-exposure is very similar to that in cut No. 3.

Cut No. 5, elevation 6,112 feet, 120 feet north 30 degrees east from cut No. 4, shows 6 inches of white quartz which contains no visible sulphide. The quartz is open at the centre of the vein and crystallization has there taken place. Original banding in the quartz is indicated by two narrow rust-streaks parallel to the walls, which may at one time have carried sulphide mineralization. A sample across 6 inches assayed: Gold, trace; silver, 0.6 oz. per ton.

The south-westerly end of cut No. 6, elevation 6,130 feet, is 500 feet north 40 degrees east from cut No. 5. The vein is exposed by continuous stripping for 85 feet from this point on a bearing of north 50 degrees east, and thence, at an elevation of 6,150 feet, the vein strikes north 20 degrees east and dips 10 degrees north-westward. A sample taken at the end of the 85-foot stripping across 21 inches of alternate bands of vuggy quartz and included granite assayed: Gold, trace; silver, 0.4 oz. per ton. The included granite has a reddish, burned look and contains more quartz than usual. The vein-quartz is barren except for leached pyrite which lies loose in drusy cavities.

The stripping on the vein continues along a bearing north 60 degrees east, and at 125 feet, at an elevation of 6,160 feet, reveals bands of rose-coloured quartz and altered wall-rock. The quartz is slightly mineralized with galena and pyrite. A sample across 11 inches, the full width of the vein, assayed: Gold, trace; silver, 0.2 oz. per ton. This marks the easterly limit of cut No. 6. Fifteen feet easterly, an adit has been driven 35 feet on a bearing north 25 degrees west. At the face of this working the vein is 10 inches wide, strikes north 45 degrees east, and dips 15 degrees north-westward.

At 135 feet from this adit, on a bearing north 70 degrees east, at 6,140 feet elevation, the portal of a second adit is visible. This was driven below the vein in a north-westerly direction. Ore is reported to have been shipped from this working. The south-westerly end of cut No. 7, at an elevation of 6,158 feet is 60 feet on a bearing north 70 degrees east from this second adit. Within this 60-foot length there are indications of possible faulting for a total vertical distance of 10 to 15 feet on the east side of one or several of a series of narrow quartz-filled fractures, which strike north 10 degrees west and dip 85 degrees westward.

At the south-westerly end of cut No. 7 a sample across 19 inches of vein-material, which included 2 inches of decomposed granite, assayed: Gold, trace; silver, 0.2 oz. per ton. The remainder, 17 inches, was composed of white, vuggy and oxidized quartz which contained no visible sulphide. Another sample across 30 inches of altered granite on the hanging-wall of the vein, assayed: Gold, nil; silver, 0.5 oz. per ton.

Cut No. 7 extends north 55 degrees east from its south-westerly end. At 90 feet from that end, at an elevation of 6,163 feet, the vein is 9 1/2 inches wide, and composed of brown-stained quartz which contains no visible sulphide. The vein strikes north 45 degrees east, and dips 10 to 15 degrees north-westward. A sample across the full 9 1/2-inch width assayed: Gold, nil; silver, 1.4 oz. per ton.

At the location of the last sample, three selected samples were taken in an attempt to determine the principal association of the gold values. One of these which was dark-brown, heavily oxidized, leached quartz, decidedly vuggy in nature, and originally, no doubt, carried considerable pyrite, assayed: Gold, 0.04 oz. per ton; silver, 6.9 oz. per ton.

The second select sample of pure white vuggy quartz, which contained no visible sulphide, assayed: Gold, 0.02 oz. per ton; silver, 1.1 oz. per ton.

The third select sample of the best quartz obtainable at this location, assayed: Gold, 0.02 oz. per ton; silver, 0.2 oz. per ton. This quartz, though oxidized and weathered, was fairly solid and shows some indication of original banding parallel to the vein-walls.

At the north-easterly end of cut No. 7, elevation 6,185 feet, at approximately 150 feet from the last sample-location additional samples were taken as follows:

Over 5 inches of vein-quartz, coloured slightly brown by iron-stain, no visible sulphide, assayed: Gold, trace; silver, 0.1 oz. per ton.

Across 16 inches of the hanging-wall altered granite which included a 1-inch stringer of quartz, assayed: Gold, trace; silver, nil.

Across 13 inches of foot-wall granite, less altered than the hanging-wall, assayed: Gold, nil; silver, nil.

Toward the south-westerly end of cut No. 7 there are indications of a third adit driven below the vein. At present, the portal is almost completely buried.

Cut No. 8, at elevation 6,210 feet, the farthest north-easterly lies 180 feet north 20 degrees east from the northeasterly end of cut No. 7. The vein is 3 inches wide, composed of well-crystallized glassy quartz, somewhat drusy, and contains minute specks of magnetite but no visible sulphide mineralization. A sample across this width assayed: Gold, nil; silver, nil.

For further information regarding the economic valuation of the Barnett vein, reference should be made to the Annual Report, Minister of Mines, British Columbia for 1921, page 141. At that time examination of the underground work was possible and it is stated:

> "The ore so far exposed is chiefly found within a length of 200 feet along the outcrop of the vein, which follows the contour of the hill in a northerly and southerly direction. Three short tunnels crosscut this oreshoot, but the vein is so flat that it remains in the tunnels throughout their entire length (the longest tunnel is 150 feet in). There are patches of ore in all three tunnels. On account of the soft, decomposed nature of the granite considerable timber is required to support the roof. The winning of ore from a small vein under these conditions is difficult and expensive."

It should be recognized that the granite was exposed only to shallow depths and will be considerably more solid at lower levels.

About 800 feet southerly from the centre adit on the Barnett vein, at an elevation of 5,625 feet, a drift-adit has been driven on the Fort George claim just westerly from the G. H. slide. This work was done to investigate one of the shears previously described. For a length of 130 feet in this drift the shear strikes north 65 degrees east and dips 75 degrees south-eastward. The shear-width varies from 10 to 40 inches and averages an estimated 22 inches within which are one or more persistent bands of quartz associated with calcite. The remainder of the shear-filling consists of gouge and crushed granite. A sample, taken at the face across 10 inches of quartz and gouge which represented the full width of the shear at this point, assayed: Gold, nil; silver, nil. Another sample was taken on the footwall-side of the shear across 44 inches of leached and altered granite in which quartz stringers are distributed irregularly. This sample, taken as far north-westerly as a fracture parallel to the shear which apparently marks the outer limit of the alteration in the granite, assayed: Gold, nil; silver, nil. Unfortunately the granite back of the working is so badly decomposed that it is not possible to take samples safely in the length of the drift.

On the G. H. claim, at an elevation of 5,595 feet, another drift-adit has been driven on a similar shear. This working is approximately 1,100 feet south 60 degrees west from the adit on the Fort George claim. The original exposure was found on the easterly side of the Lucky George slide. The drift follows the shearing, strike north 70 degrees east, dip 60 to 70 degrees south-eastward, for 75 feet. As in the adit last described, the shear is strong and well-maintained but the poor condition of the back prevents close examination or sampling along the full length of the drift. At the face, a sample taken across 18 inches of the shear, the filling of which is composed principally of vein-quartz, very slightly mineralized with pyrite, assayed: Gold, trace; silver, 1.0 oz. per ton. An additional sample, taken on the foot-wall across 14 inches of gouge and decomposed granite, assayed: Gold, nil; silver, nil. A third sample taken across 16 inches of similar wall-rock, adjacent to the shear on the hanging-wall-side, assayed: Gold, nil; silver, nil. On the surface, some 30 feet vertically above the adit, a small open-cut exposes the full shear-width of 18 inches in which is included a 4- to 6-inch streak of quartz abundantly mineralized with galena. This was the best sulphide mineralization seen on the property and a select sample of it, taken from a small dump beside the cut, assayed: Gold, trace; silver, 14.6 oz. per ton. Apart from this streak the remainder of the shear-filling consists of decomposed granite, without visible sulphide.

On the Retter claim, at an aneroid elevation of 5,635 feet, estimated at 2,100 feet north-easterly from the drift-adit on the Fort George claim, a third drift-adit has been driven on a shear believed by the owners to be the extension of the one exposed in the Fort George working. It was not possible to be certain of the elevation of the Retter adit as atmospheric conditions had been markedly affected by a severe thunderstorm at the time of the aneroid reading. For 60 feet this drift follows a shear which strikes north 50 degrees east and dips 80 degrees north-westward. This shear, filled with decomposed granite, gouge, crushed quartz and defined quartz-bands, lies between strong and well-defined granitic walls. Sulphide mineralization is pyrite and galena. Shear-widths vary up to 30 inches. A 22-inch sample of quartz, sparsely mineralized with pyrite, taken across the full width of the shear at the face of this drift, assayed: Gold, trace; silver, 2.3 oz. per ton.

A dump sample of select mineralization consisting principally of galena and smaller amounts of pyrite in drusy quartz assayed: Gold, 0.02 oz. per ton; silver, 43.2 oz. per ton.

ORO FINO. This property, at the headwaters of Nilsik (Crazy Jane) Creek, consists of the Oro Fino No. 2 and the Gold Cross Nos. 1, 2 and 3 mineral claims, held by location by Eugene Hird of Slocan City and E. J. Van Dulken at South Slocan. The claims cover the headwaters of Nilsik Creek and of Lemon Creek. Locally, surface-relief is very rugged. The surface consists principally of rock-debris and a thin, scattered layer of top-soil resulting from rapid weathering and disintegration. In the winter months, snow-slides are frequent from the side-rims and from the rim at the head of Nilsik Creek Valley and, naturally, these hamper winter-access and greatly increase the cost of winter-transportation. Access from the main Lemon Creek trail at a point slightly more than 2 miles above Oro is by 3 1/4 miles of pack-trail. For the lower 2 1/4 miles this pack-trail is extremely steep and needs considerable relocation before it would permit economical transportation by either back-packing or horse-packing. The camp and workings are at an elevation of 6,800 feet and above timber-line but timber adequate for all mining and domestic needs is available in the valley below the camp within a distance of a mile. Sufficient domestic water is available in a small creek which flows past the portals of the adits, and close to the camp-site. The camp consists of one new log-cabin, adequate for three men.

The rocks of the area are all members of the Nelson batholith. In the vicinity of the workings on this property the commonest rock-type is quartz-diorite which is frequently porphyritic. The feldspar phenocrysts may be large and are easily recognized. In the district, quartz-sulphide mineralization in the granites generally follows openings which vary from comparatively tight joints to shears several feet wide. On this particular property such mineralization occurs in a tight fracture showing little indication of movement. The walls are well defined and seldom more than a few inches apart. Maximum vein-width observed was about 12 inches, but there is reported to be a width of 24 inches at the bottom of a shallow water-filled winze. The vein-material is quartz mineralized with pyrite, galena and sphalerite. The quartz is strong in appearance with a decided blue cast in the higher grade sections of the vein. The wall-rock has been affected by hydrothermal leaching and alteration for a distance of a few inches on either side of the vein.

The original surface exposure was discovered on the northerly side of a small, well-defined draw, in granite, which strikes north 50 degrees east, toward the head of the valley-basin. The vein outcrops at an elevation of 6,945 feet, strikes north 15 degrees east and dips 85 degrees south-eastward. A drift was driven from this outcrop for 70 feet and proved the vein to maintain its strike and dip as originally exposed. In this working vein-widths vary from 3 to 12 inches. At 18 feet from the portal a winze has been sunk on the vein to a reported depth of 20 feet. Surface-stripping to the north indicates vein-continuity for a distance of about 250 feet from the portal of the adit, but in a southerly direction there is no definite indication of the vein-extension on the southerly wall of the draw, at a distance of 75 feet from the portal.

At approximately 190 feet south 40 degrees west from the upper adit-portal a crosscut has been driven on the southerly side of the draw at an elevation of 6,840 feet. This working follows an erratic course in a general north-easterly direction. Details of underground exposures provided by this work are of interest. At 86 feet in a north-easterly direction from the portal a shear was intersected which strikes north 80 degrees east and dips flatly southward. This was followed for 50 feet and then the working swings north-easterly for 36 feet at which point another shear was intersected. This second shear strikes north 70 degrees east and dips 60 degrees southward. A drift driven along it for 47 feet north-easterly, exposes a strong shear which suggests considerable movement between its walls. From the point at which the adit first intersected this shear it was continued for 23 feet north 15 degrees east, and then for 19 feet north 70 degrees west to an intersection with a vein which strikes north 15 degrees east and dips vertically. This vein, about 3 inches wide, was followed for 13 feet to the north. In this working the vein is tight, narrow, and composed of quartz mineralized with pyrite and galena. Wall-rock alteration extends for 6 inches into both walls.

Measurements in the foregoing are accurate only within the limits of pace and compass measurements but by these methods it was possible to prove close correlation between the vein at the face of the lower adit and that exposed in the upper one. The indications are that the shearing exposed in the lower working and that indicated on the surface by the draw are two representations of one considerable movement which has probably displaced the southern extension of the vein. Contributory evidence was supplied by the operators who claim that there was sulphide mineralization in the more northerly shearing underground at the point at which the adit first intersected it. This mineralization extended for a few feet to the north-east as irregular dissemination in the shear. At the time of examination the writer did not see this sulphide, but if it can be recognized as drag-mineralization it indicates that displacement of the vein has been to the east on the southerly side of the shear. Close to the portal of the upper adit a small dump contains about two tons of sorted high-grade and about twelve tons of apparently lower-grade ore.

Samples taken from the property were as follows:

(1) Across 24 inches of shearing, silicified, slightly mineralized with pyrite, at 10 feet from the portal of the lower adit, assayed: Gold, trace; silver, 1.2 oz. per ton. This shearing strikes north 40 degrees east, dips 55 degrees south-eastward, and is part of the main shearing indicated by the draw on the surface above.

(2) Across 8.5 inches of vein well mineralized with pyrite, galena and sphalerite, at 18 feet from the portal of the upper adit over the centre of the winze, assayed: Gold, 1.22 oz. per ton; silver, 18.4 oz. per ton.

(3) Across 5.5 inches of vein sparsely mineralized with pyrite, at the face of the upper adit, assayed: Gold, trace; silver, 0.4 oz. per ton.

(4) General grab-sample from the 2-ton, high-grade dump, of blue-coloured quartz mineralized with some pyrite, galena and a small amount of sphalerite, assayed: Gold, 1.52 oz. per ton; silver, 16.7 oz. per ton.

HUDSON'S BAY GROUP. This group consists of two Crown-granted claims, the <u>Nansen</u> and <u>Fram</u>, which are owned by the Hudson's Bay Company and leased from that company by W. Allen and J. Williams, of Nelson, B. C. The property is located at the head of Lemon Creek, and is accessible from the Trans-provincial Highway, just east of Nelson, by 7 1/2 miles of poor but passable road and 8 1/2 miles of trail, as described in the introduction. The trail, to within a mile of the camp, passes through standing-timber sufficient and suitable for construction or mining on the property. For the last mile the trail is above timber-line and lies on the north-westerly side of Lemon Creek Valley. The rim on this side of the valley rises above the trail to a minimum height of 1,000 feet. The result is that this section is extremely dangerous in winter and spring on account of snow-slides. The claims are located on the slope to the south-west which forms the head of Lemon Creek Valley; the rim between this slope and Glory Basin, to the north-east, is lower in elevation than either the north-west or south-east rims of the valley. The camp, at an elevation of slightly over 6,200 feet, consists of one building, adequate for two men. Immediately to the north-west of the camp a small stream flows from the north-east. This stream has a drop of at least 300 feet within a short horizontal distance and, on August 26th, there appeared to be sufficient water to provide power for a small summer-operation. The workings lie within 350 feet of the camp, on the north-westerly side of the creek. Immediately west of the adits a small but rugged draw strikes northerly and defines the junction of the north-west side-wall and the north-east end-wall of the valley.

The rock of the area is porphyritic granite typical of the main Nelson batholithic mass. In the immediate vicinity of the showings there is an exposure of porphyritic granite which is brown to reddish-brown in colour and in marked contrast to the characteristic grey of the surrounding rock. This granite appears to have a width of about 100 feet and to strike slightly east of north on the east side of the small draw beside which the adtis have been driven. The exact structural nature of this red granite was not determined but apparently it is a slightly later phase of the original granite intrusive following a general irregular line of weakness within the main mass. In support of the assumption of such weakness, in the floor of the draw in the ordinary granite, lamprophyre dykes are exposed which vary in width from 2 to 4 feet and strike generally north with the trend of the red granite.

The occurrence under investigation consists of a series of narrow quartz veins which strike generally north and apparently follow the broad line of weakness indicated by the reddish-coloured granite. These veins occur principally within the red granite but the irregularity of the margins of this rock and the presence of inclusions of the ordinary granite within it create considerable local variation of wall-rock along the strike. The filling of the fissures varies from compact, bluish-quartz to gouge and sheared wall-rock. Where shearing and gouge are present there is usually a narrow but persistent width of solid quartz. In addition to the principal fissuring several others strike from it at flat-angles. Sulphide mineralization, confined principally to the defined widths of quartz, and present in both main fissure and branches, is usually pyrite and galena.

Quartz widths are seldom more than 12 inches and the average total width between fissure-walls does not exceed 20 inches. Movement, later than that responsible for the original openings, is demonstrated by occasional "en echelon" structure of the quartz whereby successive segments of the vein overlap or lie side by side and parallel. In general the evidence indicates that the branch-fissures to the south-west are later than the main fissure, but there are at least two exceptions to this rule exposed in the underground workings.

Any surface workings are obliterated owing to the extensive action of the snow and subsequent slides in spring season. The underground workings consist of two drift-adits connected by a vertical raise. The upper of these two, at an elevation of 6,193 feet, is 134 feet long; the lower, at an elevation of 6,180 feet, is 79 feet long. The raise is 79 feet from the portal of the upper adit and 10 feet from the face of the lower adit. The vein in the upper drift strikes almost north and dips predominantly at steep angles to the west, although it is typically sinuous in a vertical plane and commonly there may be a steep reversed dip to the east. In this drift the fissure-width averages slightly under 20 inches and the defined quartz-width, as one or two stringers, varies up to 11 inches. Continuity of the vein is well maintained over the whole length of this drift and sulphide mineralization is consistent except, at and close to the face, where the vein pinches to a 1 1/2-inch quartz stringer, and an additional inch of shearing on the east side of the stringer, and a 12-inch shearing on the west. One well-defined branch-fissure, which strikes north 32 degrees east, and dips 65 degrees north-westward, is well exposed where it enters the vein at 72 feet from the portal. In this branch-fissure sulphide-bearing quartz has widths up to 3 inches.

The lower adit was driven originally on a quartz stringer which seldom exceeds 1 inch in width in the first 21 feet from the portal. This stringer, at present exposed on the westerly wall of the drift, strikes north 60 degrees east, and dips predominantly steeply to the north-westward but, as in the exposure in the upper level, this dip may be complicated by rolling irregularities which produce local steep dips to the south-eastward. At 21 feet from the portal the working intersected another quartz stringer on the east wall which strikes north 20 degrees east, dips 35 degrees to 50 degrees north-westward and varies from 2 to 4 inches wide. At this point the original vein on the west side of the drift consists of 1 1/2 inches of quartz which contains a considerable amount of sulphide. There is but little doubt that these two exposures are the results of two distinct movements because from this point onward, in the drift, it is possible to trace these two veins, parallel to each other in the back of the drift and intersecting near the floor on the west side. This condition suggests that the steep one on the west side of the drift was earlier than the other. At 43 feet from the portal the vein on the east wall attains a maximum width of 6 inches. At this point it is joined by a strong fissure that strikes north 5 degrees west, dips almost vertically, and comes in from the east wall. This fissure is apparently earlier than the vein previously followed by the east wall drift because the vein takes the direction and dip of this fissure and continues within its limits as a well-maintained width of quartz. The persistence of this structure is, however, short-lived as shown by a short crosscut to the east at 60 feet from the portal. This additional exposure into the east wall shows the vein-quartz to become weak and pinch to a width of 1 inch. From the portal, plus 22 feet, the stringer originally followed on the west wall gradually widens to 8 inches at the raise and comprises well-banded quartz heavily mineralized with sulphides. At the face this vein-structure is represented by 30 inches of shearing including one 4-inch width of quartz and some quartz stringers. There are practically no sulphides in any part of the total width.

In the crosscut from the lower level, which has been driven easterly for a distance of 15 feet, a 2- to 3-inch quartz stringer is exposed which contains a considerable amount of sulphide, strikes north 10 degrees east and dips vertically. Although the difference in elevation between the two drifts is small it is perhaps unwise to attempt definite correlation between the various exposures in each. At the raise there is a continuous exposure of quartz between the principal vein which follows the west wall of the lower drift and the vein-exposure on the upper level. Beyond this, however, it becomes difficult to attempt to define the relationship between the various branch-stringers on the two levels. If work is continued it should be on one of these drifts only to avoid unnecessary duplication of conditions which must be essentially the same within this very small vertical range.

Samples taken were as follows:

From the upper adit

No. 1. At portal plus 20 feet, across 22 inches, the full width of the shear including 6 inches of quartz on the west side and 6 inches of quartz on the east side, slightly mineralized with pyrite, assayed: Gold, nil; silver, 0.8 oz. per ton.

No. 2. At portal plus 72 feet, across 27 inches, the full width of the shear at the junction of the main vein and a branch-vein including a 1 1/2-inch quartz stringer which contains a considerable amount of galena and pyrite, assayed:

Gold, 0.04 oz. per ton; silver, 5.5 oz. per ton.

No. 3. At portal plus 83 feet, across 11 inches of solid quartz, well mineralized with galena and pyrite, assayed: Gold, 0.04 oz. per ton; silver, 8.4 oz. per ton.

No. 4. At the face, across 1 1/2 inches of quartz sparsely-mineralized with pyrite and galena, assayed: Gold, 0.1 oz. per ton; silver, 21.3 oz. per ton.

From the lower adit

No. 5. At the face, across 25 inches, the full width of the shear which includes 12 inches of quartz on the west side and 1 inch of quartz on the east side, slightly mineralized with pyrite and galena, assayed: Gold, 0.1 oz. per ton; silver, 1.3 oz. per ton.

No. 6. At portal plus 60 feet, at the junction with the crosscut to the east, across 8 inches of quartz mineralized with pyrite and galena, assayed: Gold, 0.02 oz. per ton; silver, 8.5 oz. per ton.

No. 7. Immediately to the east of No. 6 sample, in the crosscut, across 74 inches of slightly-altered granite which contained no visible sulphide mineralization, assayed: Gold, nil; silver, nil.

No. 8. Immediately to the east of No. 7 sample, in the crosscut, across 55 inches of slightly-altered grey granite, assayed: Gold, nil; silver 0.5 oz. per ton.

No. 9. Immediately to the east of No. 8 sample, across 6 inches of quartz and sheared granite which contained pyrite and galena, assayed: Gold, 0.04 oz. per ton; silver, 13.7 oz. per ton.

No. 10. At portal plus 25 feet, across 53 inches, which included the 1 1/2-inch quartz vein which contains sulphide on the west wall and the 2-inch quartz vein sparingly mineralized on the east wall, assayed: Gold, trace; silver, 0.6 oz. per ton.

No. 11. A sample of select sulphide mineralization from the lower level assayed: Gold, 0.22 oz. per ton; silver, 38.4 oz. per ton.

LYLE CREEK-WHITEWATER CREEK AREA.

References

Annual Reports, Minister of Mines, British Columbia, 1899, 1901, 1920, 1928, 1929, 1933 and 1937. Of these only the last two provide detail.

C. E. Cairnes, Memoir 173, Geological Survey, Canada, "Slocan Mining Camp, British Columbia."

C. E. Cairnes, Memoir 184, Geological Survey, Canada, "Description of Properties, Slocan Mining Camp, British Columbia."

Introduction

Descriptions of the general geology and of lode-gold occurrences of possible economic interest in the Lyle Creek-Whitewater Creek area are based principally upon data obtained by examination of the Highland Surprise. Although this property was reported upon thoroughly by H. Sargent in the Annual Report, Minister of Mines, British Columbia, 1937, results of development-work since that time have been sufficiently favourable to warrant closer examination of structural and economic conditions at that property, and in the area indicated as on the strike of the deposit.

The Lyle Creek-Whitewater Creek area is 2 1/2 to 3 miles slightly east of north from the town of Retallack, a station on the Kaslo-Sandon and Nakusp branch line of the Canadian Pacific Railway, and on the Kaslo-New Denver highway, 18 miles from Kaslo and 13 miles from New Denver.

Access to Lyle Creek Basin is discussed fully in the Annual Report, Minister of Mines, 1937. At that time it was possible to drive over the Whitewater Mine road for a mile out of Retallack, but for an additional 3 miles access was by trail. Since 1937 a road has been built, in part over the old trail location for slightly more than 2 miles, from the Whitewater Mine road. This additional length of road enters the basin and climbs its north-westerly wall to within three-quarters of a mile of the Highland Surprise camp. From the end of this road, at slightly over 3 miles from Retallack, a good skid-trail extends to the camp. Although on good grade and adequate for transportation by car and intermittent use by trucks, the newly-constructed 2 miles of road would require further removal of "toe-rock" and some additional cribs to permit continual heavy haulage. In winter, snow-slides make the upper mile of road dangerous and sometimes impassable, and, in the event of any major operation centered in Lyle Creek Basin it would be well to consider the advisability of using an aerial tram either to obviate this section only or to connect directly from camp to the railroad, the latter an air-line distance of close to 2 miles.

Whitewater Basin lies north-westerly from Lyle Creek Basin, and is separated from it by a steep ridge which rises 1,200 feet above the floor of the former and 1,800 feet above the floor of the latter. This condition makes it impractical to consider transportation directly from one basin to the other and access to the Whitewater Basin is from the point at which the Lyle Creek road leaves the Whitewater Mine road. From this junction which is slightly over a mile from Retallack a poor road extends for a mile to the Keystone-Charleston camp; thence a pack-trail follows Whitewater Creek up-stream for an additional mile to the south-eastern end of the basin. From this end, to the mountains which rim it on the north-west, Whitewater Basin is 3 miles long and for this distance it is traversed by a trail adequate for foot-travel and pack-horses. A road, on good footing and well protected from snow-slides, could be made from the turn-off at the Lyle Creek Basin road to the lower, south-eastern end of Whitewater Basin, but in this distance the lower mile of the present road to the Keystone-Charleston camp would need a considerable amount of repair and probably slight relocation. For the upper mile a road on good grade could follow the present pack-trail with only slight deviation, but it would be necessary to construct five small bridges; one of them across Whitewater Creek.

Topography

The area is one of strong relief. Elevations rise to 9,000 feet at the summits of sharply-pointed mountains and serrated ridges which are aligned to form ranges of generally north-westerly trend. The valleys between the ranges are deeply-incised. The annual spring run-off is heavy and reduced flow is maintained throughout the summer from melting ice which still lies in glacial cirques at the heads of the higher basins. The precipitous slopes of the higher walls of the valleys are reduced at lower elevations by accumulations of talus and morainal material. Surface-erosion is so active that development of upland meadows is rare.

Evidences of glaciation are common in the area. Many of the softer rocks have rounded outlines on the surface, from which glacial grooving has been removed by later surface-erosion; on more resistant rocks, however, striae are frequently well preserved. One very interesting exposure was observed on the high south-westerly rim of the Whitewater Basin where well-defined striae trend southerly. At this location the wall of the basin is almost vertical for 900 feet and the striae are at the top, on the very edge of the rock-rim which slopes 25 degrees southward, or, away from the rim and Whitewater Basin. This suggests a comparatively recent movement of ice from higher ground above the present basin. It is clearly recognized that the serpentine underlying the basin has been considerably more subjected to erosion than the volcanic members which flank it to the south-west. This illustration of the ratio between the two rates of erosion is startling and indicates that local topographic features can be given little weight in consideration of any but very recent events.

A combination of topographic and climatic conditions render year-round operation difficult. Heavy snowfall during the winter months produces many slides which frequently make it impossible to travel or work on the surface with safety. Snow lies at higher elevations until July and is seldom gone even from the basins, at a mean altitude of from 5,000 to 5,500 feet, until late in June. Although in the ordinary year at least three months of clear weather may be expected, rain hampered field work until the end of June, 1939, and snowstorms prevented work entirely during one week in July.

Timber-line is close to 6,000 feet and below this elevation there is adequate timber available for all domestic, constructional and mining needs. Fir, pine and cedar are abundant below 5,500 feet at locations sheltered from snowslides and not subject to the effects of active erosion.

Available water is subject to seasonal fluctuation and practically all the small creeks in which there may be a good flow, up until July are completely dry by the end of August. The exceptions are Lyle Creek and Whitewater Creek, but even these are greatly reduced by the time seasonal run-off is complete. As may be seen on Fig. 3, a little lake lies high above and on the northerly side of Lyle Creek basin. A small dam could be built easily at the present outlet to give a probably sufficient storage of water to provide hydro-electric power for at least six months in the year for any operation which might be expected in Lyle Creek Basin. If necessary, a second small dam some 400 feet westerly from the present outlet, across an older stream-channel, would raise the lake-level still higher.

Camp-sites are rare at elevations above 5,000 feet owing to the prevalence of snow-slides off the shear walls of the mountains which surround the basins. Within Lyle Creek Basin proper there is no good camp-site because slides run from the east, west and north and the nearest location which is safe and satisfactory is on Lyle Creek, about 3,000 feet below the southern margin of the basin, close to the point where the Eureka Mine road leaves the Lyle Creek road. At this location it would be possible to establish a camp at the level of Lyle Creek, secure from the danger of slides by a good stand of timber and comparatively gentle slopes on the hillsides above.

On Whitewater Creek it would be possible to obtain good camp-sites between Whitewater Mine camp and the lower end of Whitewater Basin but there are no safe locations anywhere within the basin proper.

General Geology

The rocks of the area under consideration belong to the Kaslo series of Triassic age. In Memoir 173, Geological Survey, Canada, C. E. Cairnes divides this series into volcanic rocks, intrusives, serpentine and sediments, and subdivides the volcanic rocks into pyroclastics and flows. However, even with Cairnes' findings available, the distinctions between many of these rocks are so slight that for the prospector or field engineer it is frequently extremely difficult to identify individual rock-members. In appreciation of this an effort will be made to simplify the descriptions and groupings of the various members as far as possible and to emphasize only the points of principal difference.

The rocks of the region have been subjected to dynamic and hydro-thermal metamorphism, which has obscured many of their original characteristics and the contacts between the individual members. Although it is not possible to be certain, it is probable that much of the volcanic material was originally andesitic in composition. Because most of the volcanic rocks are chloritized it has been found convenient to classify the pyroclastic, flow and sedimentary members as greenstones. The sediments should, probably, not be included in this classification but in the area they are not abundant and scarcely distinguishable from the volcanics. The dioritic intrusives, serpentine and feldspar-porphyry dykes are easily identified by the characteristics given below.

Greenstone (includes original flows, pyroclastics and sediments)

Of the three original constituent members, the flows are the only ones which may be identified with any degree of ease.

They are typically pale-green or light-green on the weathered surface, slightly darker-green or grey when freshly fractured, and fine-to medium-grained in texture. The diagnostic feature is flow-structure which is apparent, occasionally, on a broad scale. This structure is visible when seen in place in its entirety, but seldom authoritative in fragmentary hand-samples, and is generally represented by fine lines or elliptical outlines of colour either lighter or darker than the remainder of the rock. The lines occur as bands which are generally confined to a width of a few inches but gradual divergence between the lines may increase the width of the band to 2 or 3 feet. The colour-variation is probably the result of differential weathering as the result of mineralogical differences between the lines and the surrounding rock. The impression is gained that the lines were drawn out by movement while the rock was still in a plastic condition. Occasionally, it is possible to find fragments either adjacent to these bands of lines, or within them, that show definite elongation parallel to the length of the bands. Twice elliptical outlines were observed which were up to 3 feet in length and up to a foot wide. Cracks transverse to the length of the ellipse were as much as an inch wide. These cracks may have been filled at one time but all those seen were empty. This occurrence suggests elongation when in a plastic state, and, extended tensile stress parallel to the length of the outline after further cooling. It is possible that these forms represent flattened pillow-structure. Such flow-structure is seen to the best advantage on the south-westerly side of the serpentine. Where flow-structure is not available as a guide and the groundmass is fine-grained and homogeneous, as in large areas on the north-easterly side of the serpentine, it is sometimes possible to distinguish the flows by means of isolated fragments of unabsorbed earlier crust. However, these criteria are unreliable because the isolated fragments may often be coarse fragmental material in finely-divided pyroclastics.

A few examples of the pyroclastics were seen, notably underground at the <u>Highland Surprise</u>, where it was possible to define at least small areas with some assurance. Under a hand-lens, or occasionally in the hand-specimen, these rocks may be seen to be fragmental in origin.

Apparently sediments are rare in this section and none were seen with characteristics as defined by Cairnes. This, however, is not surprising as they are prominent nowhere in the Kaslo series. There may be some sediments exposed underground at the <u>Highland Surprise</u> but the writer saw no rock that could be classified definitely as such, although there are several exposures in which bedding appears obvious at first sight. Closer examination of these exposures shows, however, that the illusion is created by a nearly parallel arrangement of quartz and albite stringers that follow lines of shearing in highly metamorphosed rock which originally was probably pyroclastic.

Serpentine

Within the map-area the serpentine is the most extensive and well-defined member of the Kaslo series. It traverses the entire length of the sheet, on a north-westerly strike, steeply dips to the south-west and is exposed in widths up to 2,500 feet. The generalized statement that the dip of the serpentine is steeply to the south-west is based on the variation in surface outcrops with change in elevation, over the entire length of the map-area. There are obvious local variations, as at the head of Whitewater Creek, where the dip is 50 degrees southwestward, and underground at the Highland Surprise, where it is steeply eastward. Mapping of this rock is facilitated by the fact that, owing to its softness, erosive action has formed well-defined depressions on the surface above it. The best example of this is found in the Whitewater Basin, where practically the whole basin is underlain by serpentine. In some places the south-westerly margin of the basin is sheer and almost vertical to a height of 1,000 feet, and closely defines the contact between the serpentine and the greenstone to the south-west. Well-marked draws, on both sides of the divide, between Whitewater and Lyle Creek Basins also define the serpentine surface-outline.

On weathered surfaces the colours of the serpentine are typically black, or shaded from dull to bright-green, pink or light-brown; the last two colours grade frequently to a dull-white. The extreme softness and decided greasiness are easily recognizable characteristics. The greasiness is due to the abundant production of talc as the result of alteration. Fibrous appearance along shear-planes is due to the production of chrysotile (asbestos).

As outlined by Cairnes, the member probably represents an original ultrabasic injection which has reached its present composition by simple hydration or other more involved metamorphic processes. That it was originally intrusive is emphasized by inclusions of greenstone and by the narrow but well-defined branches which diverge from the main mass. On Fig. 3 several of these fingers are indicated to the south-west of the main body. To the north-west it is claimed that the serpentine may be traced along its strike for 3 miles beyond the head of Whitewater Creek. Although the writer made

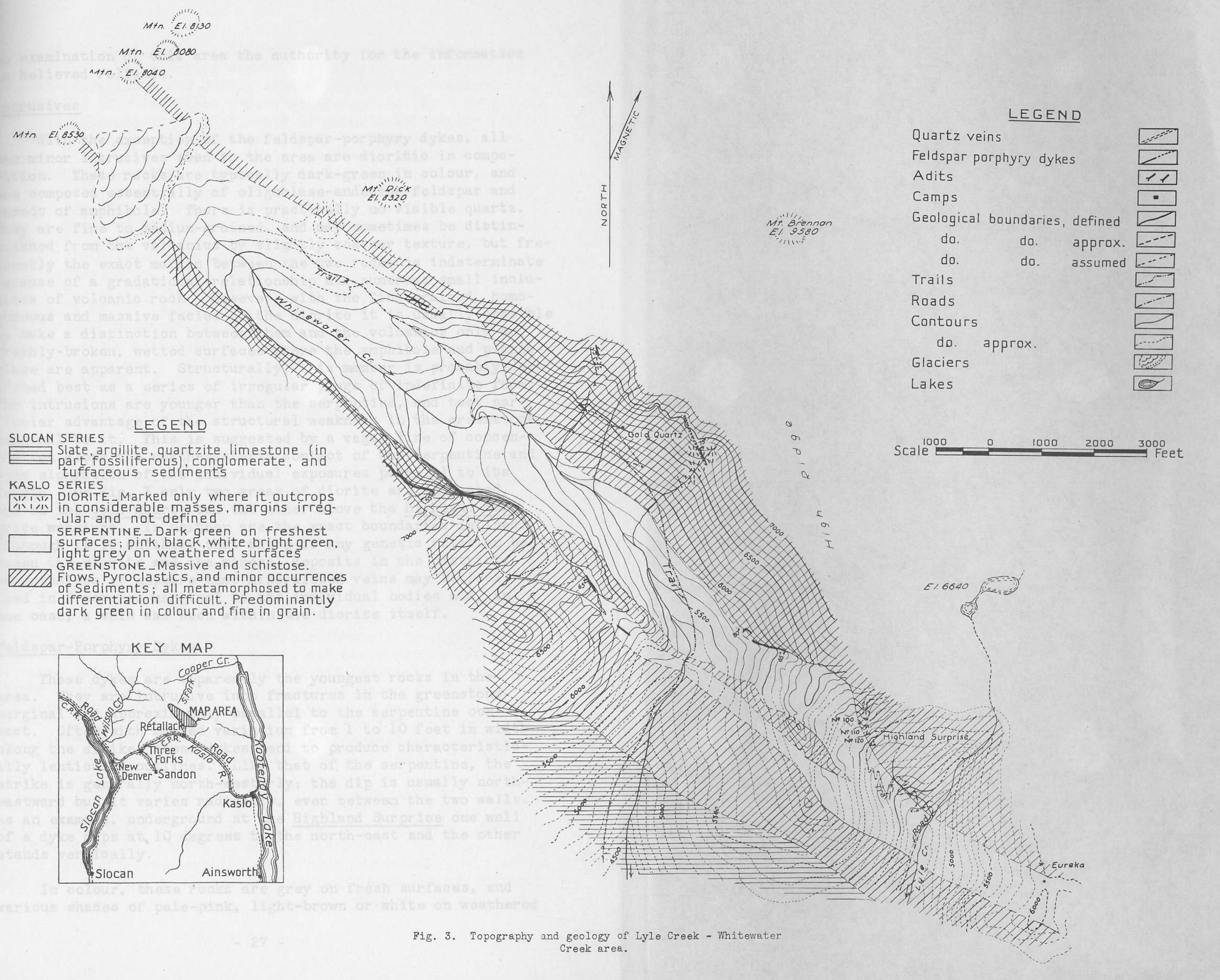

Fig. 3. Topography and geology of Lyle Creek - Whitewater Creek area.

no examination of this area the authority for the information is believed reliable.

Intrusives

With the exception of the feldspar-porphyry dykes, all the minor intrusives seen in the area are dioritic in composition. These rocks are typically dark-green in colour, and are composed essentially of oligoclase-andesine feldspar and shreds of amphibole. There is practically no visible quartz. They are fine to medium-grained, and may sometimes be distinguished from the volcanics by slightly coarser texture, but frequently the exact margin between the two rocks is indeterminate because of a gradational relationship and numerous small inclusions of volcanic rock. However, with the fine-grained, homogeneous and massive facies of the diorite it is usually possible to make a distinction between them and the volcanics only on freshly-broken, wetted surfaces where the amphibole and plagioclase are apparent. Structurally, this member is probably described best as a series of irregular plugs of indefinite form. The intrusions are younger than the serpentine, and took particular advantage of the structural weakness in the greenstone marginal to it. This is suggested by a vague line of concentration along the north-easterly contact of the serpentine and some elongation of the individual exposures parallel to its length. On Fig. 3 only two areas of diorite are indicated, one on the Gold Quartz and the other above the Highland Surprise workings. In neither are the exact boundaries defined. Although it is unlikely that there is any genetic relation between the diorite and the mineral deposits in the district, nevertheless it appears that mineralized veins may be localized in fractures marginal to the individual bodies and, in one case, a vein was seen within the diorite itself.

Feldspar-Porphyry Dykes

These dykes are apparently the youngest rocks in the area. They are intrusive into fractures in the greenstone marginal and approximately parallel to the serpentine contact. Often with marked variation from 1 to 10 feet in width along the strike, these dykes tend to produce characteristically lenticular outlines. Like that of the serpentine, the strike is generally north-westerly; the dip is usually northeastward but it varies radically, even between the two walls. As an example, underground at the Highland Surprise one wall of a dyke dips at 10 degrees to the north-east and the other stands vertically.

In colour, these rocks are grey on fresh surfaces, and various shades of pale-pink, light-brown or white on weathered surfaces. The composition is markedly uniform throughout the area. In a fine-grained feldspathic ground-mass, plagioclase phenocrysts are abundant, quartz grains are usually absent or nearly so, and carbonates are freely developed. In addition to the plagioclase, which is principally albite-oligoclase, minor, variable amounts of orthoclase are present. These feldspars are ordinarily somewhat sericitized. Subordinate minerals are biotite, actinolite and epidote. Noticeable amounts of pyrite and some chalcopyrite are often present.

Veins

Two types of vein-occurrence have been exposed at the Highland Surprise. Both are in the fractures of north-westerly strike in the greenstone marginal to the serpentine. For purposes of identification one type will be referred to as "vein," the other as "vein-zone." The veins are composed of quartz and calcite gangue which contains gold-bearing sulphides; principally pyrite and chalcopyrite. No free gold was seen in hand-specimens but microscopic examination shows it to occur as blebs in the pyrite. Samples from the Highland Surprise yielded a considerable amount of free gold on the Haultain Super-Panner.

The veins on the north-easterly margin of the serpentine have proved, upon development, to be sufficiently mineralized with gold-bearing sulphides to warrant serious consideration. Those on the south-westerly margin, by evidence of surface exposures alone, are almost barren of sulphides. Those on the south-westerly contact appear to have been deposited at comparatively low temperatures; drusy structure is common, wall-rock alteration is almost absent in many places, and several angular and unaffected inclusions of wall-rock were noted within the vein-quartz.

To date, development indicates weakness and irregularity of the veins both along the strike and on the dip. The veins have naturally assumed the habit of the fractures and, like the feldspar-porphyry dykes, are variable in width along the strike. However, the veins are even more irregular than the dykes, particularly where the wall-rock is highly sheared, for, although the general occurrence of vein-quartz may continue on strike, individual strands are often highly contorted and irregular in dip as a result of having followed minor local folds and fractures in the greenstone. In other places the width of vein-quartz may pinch abruptly to a single narrow stringer. Vein-widths vary up to 5 1/2 feet of either solid quartz or of several strands or lenticular bunches of quartz and included low-grade rock. Where the vein and a feldspar-porphyry dyke occur together in the same fracture the vein gains strength from the competency of the dyke.

The vein-zones may be representative of the veins at locations where vein-solutions were not abundant and where fractures of the greenstone were represented by tight shearing rather than by well-maintained openings. In at least one case there is, apparently, a transition along the strike from vein-zone to vein. The width of the vein-zones is comprised of very narrow stringers of albite and quartz which strike north-westerly. Pyrite is disseminated sparsely in the quartz, in the albite, and in the included and marginal greenstone. The marginal greenstone is highly altered, and often dark in colour, homogeneous and compact. To date, the gold content in the vein-zones has been found to be small but if transition from them to the veins is proved, the zones may be followed as a guide in development.

The veins may prove to be simple shoots within the vein-zones or there may be cross-fracturing of the vein-zone shearing and the intersections of the two sets of fractures may have permitted concentrations of mineralization along the cross-fractures. Nowhere was it possible to see two fracture-systems which actually crossed, but at two locations veins which contain commercial values strike north to north-east as against the general vein-zone strike to the north-west. In the course of further exploration particular attention should be given to the possibility that there is such a secondary and less conspicuous fracture-system.

Relative Ages of Veins and Feldspar-Porphyry Dykes

The close areal association of veins and dykes suggests that there may be some genetic relation between them.

At the Gold Quartz there is at least one good exposure in which quartz stringers branch from a strong vein and fill fractures in a dyke which forms the vein-wall. Study of these sections show that the feldspars in all the dykes are closely related. There are many examples of definite inclusions of albite within the veins; this mineralization may be a final differentiate of the dyke-magma.

The weight of evidence thus indicates that the intrusion of the dykes closely preceded the mineralization of the veins.

Regardless of theoretical considerations the fact remains that the close association between the dykes and veins is found throughout the area and thus the dykes may be used as a competent guide in the course of vein-development.

Structure

As described by Cairnes, "the Kaslo rocks form an almost structureless mass." However, in his report he gives such data as are available concerning the thickness of the Kaslo series and the nature of the contacts with the underlying Milford series and the younger Slocan series. On Fig. 3 the contact of the Kaslo and Slocan series is indicated and, as described by Cairnes in the area farther south-easterly, there is little apparent discordance between the two series. The Kaslo-Milford contact does not occur in the area under consideration but its extension from the location as mapped on Cairnes' sheet is exposed approximately 1 1/2 miles north-easterly from the north-westerly limit of this area. At that point, the contact crosses the south fork of Cooper Creek where its general line may be distinguished easily by the marked difference in the weathering of the two formations. The slate, argillite and limestone of the Milford Group weather with characteristically rounded outline in strong contrast to the ruggedness of the Kaslo series.

On the basis of Cairnes' aereal work the strike of the Kaslo series is taken as north-westerly and the dip steeply south-westward. Intense shearing, coincident with and subsequent to folding, has produced marked schistosity parallel to the bedding-planes. Much of this shearing probably occurred just prior to the intrusion of the Nelson batholith. In unsheared and slightly-sheared greenstone at least three sets of joints have been developed; one set strikes north-westerly, dips steeply south-westward; the second strikes north-westerly, dips flatly south-westward, and the third strikes north-easterly, dips steeply south-eastward.

On the evidence available, veins and feldspar-porphyry dykes strike north-westerly and dip north-eastward or south-westward. One possible explanation of the origin of the fractures in which the veins and dykes occur is that the fractures were formed by the intrusive action of the serpentinized sill. If so, there may be a set of conjugate fractures as suggested previously in discussion of vein-structure. A second possible explanation of the origin of the fractures is that the serpentine behaved as a structural unit during the folding of the older rocks, and produced fractures against and nearly parallel to the serpentine contact. A third possible explanation is, that the fractures were caused by strains produced in the marginal rocks during change in volume within the sill, attendant upon change in composition from the original rock to serpentine.

It should be understood that the veins and feldspar-porphyry dykes only parallel the serpentine contact approximately. Fig. 4, of the <u>Highland Surprise</u> underground workings, which accompanies this report, shows variation between the strike of the veins and dykes and that of the serpentine of as much as 30 degrees, and a tendency for the veins to strike slightly farther to the west than the serpentine contact.

Alteration

Cairnes treats this question of alteration and considers most of the effects to be caused by hydrothermal action. He remarks, particularly, on the alteration of the serpentine to talc and carbonate in the vicinity of the veins on the Highland Surprise. This effect is so far advanced that where intersected by underground workings, the walls and backs of the adits may be supported only with difficulty.

Wall-rock alteration adjacent to the veins is generally confined to widths which may be as much as 6 feet but which are often considerably less. In the vein-zones alteration has taken place in the greenstone which remains within the limits of the zone as well as in the marginal rock. Microscopic examination of typical greenstone wall-rock adjacent to a narrow vein showed abundant plagioclase feldspar, abundant carbonate, and chlorite as the only remaining ferro-magnesian mineral. The rock here is veined with quartz and albite. Typical of this alteration is the darkened colour of the rock and the presence of scattered pyrite. At the Highland Surprise this unsilicified, dark-coloured, sparingly-pyritized wall-rock, where marginal to veins, will often contain sufficient value in gold to be of milling-grade. Marginal to the low-grade vein-zones this rock is not found to be of value.

There has, apparently, been little or no active emanation from the feldspar-porphyry dykes; the only effect has been to bake the greenstone for a very narrow width at the contact.

HIGHLAND SURPRISE. This property was reported upon completely in the Annual Report, Minister of Mines, 1937, and although some data given in the following may be repetitive they are included here for completeness.

The principal claims are the Phoenix and Fletcher, both Crown-granted and owned by the Highland Surprise Gold Mines, Ltd. The company also holds seven other Crown-granted claims, one other Crown-granted fraction and two claims and one fraction by right of location. However, as stated in 1937, practically all the work done has been confined to the Phoenix and Fletcher claims.

The workings are located on the north-westerly side of Lyle Creek Basin, as detailed in the foregoing general description of the area. Access from Retallack is by slightly over 3 miles of fair road and by three-quarters of a mile of trail. The upper mile of road could be maintained in the winter only with considerable difficulty owing to the frequency of snow-slides. The present camp-site is some 700 feet in elevation above the end of the road, and is poorly situated and inadequately protected from snow-slides. On both sides of the buildings, slides run badly in the spring and rock-excavation and cribs have been required in the construction of bunk-house, cook-house and a dry-room adequate for twelve men. It would be unwise to consider construction of a permanent camp at this location. Further, there is no safe camp-site within the limits of Lyle Creek Basin. The nearest satisfactory site is some 3,000 feet south-easterly from the point at which the road enters the basin, beside and at the level of Lyle Creek. At the present camp, power is provided by a small diesel-plant. Domestic water is taken from a spring encountered in the underground workings. Timber is scarce at elevations above the floor of Lyle Creek Basin but may be obtained locally within a radius of 2 miles. Water-power available is detailed in the foregoing general statement.

Topography

On its north-easterly and easterly sides, Lyle Creek Basin is rimmed by peaks which rise to elevations of between 6,000 and 9,000 feet. Usually barren of timber and marked by the courses of heavy snow-slides, these walls offer but slight protection from the downward movement of snow during the winter and spring months. Twenty feet of snow on the floor of the basin is not unusual in February and March. Lyle Creek enters the basin over a lip of the north-easterly rim. From the lake, indicated on Fig. 3, the creek falls 1,300 feet in a horizontal distance of 2,500 feet. The lake is maintained by glaciers above, and could be dammed to provide water-storage.

General Geology

Considerable detail applicable to this particular property has been given already in the general statement. The rocks exposed underground are greenstones, as defined previously, of the Kaslo series, intruded by irregular masses of diorite and by feldspar-porphyry dykes. The underground workings follow the margin of the basic intrusive, now converted to serpentine, and the veins and the dykes both parallel approximately the contact between the serpentine and the greenstone. The greenstone is schistose and largely chloritized; in proximity to the veins it is commonly darkened by hydrothermal alteration.

As detailed in the general statement, distinction is made between two types of vein-structure which are designated as "vein" and "vein-zones" respectively. Further development is

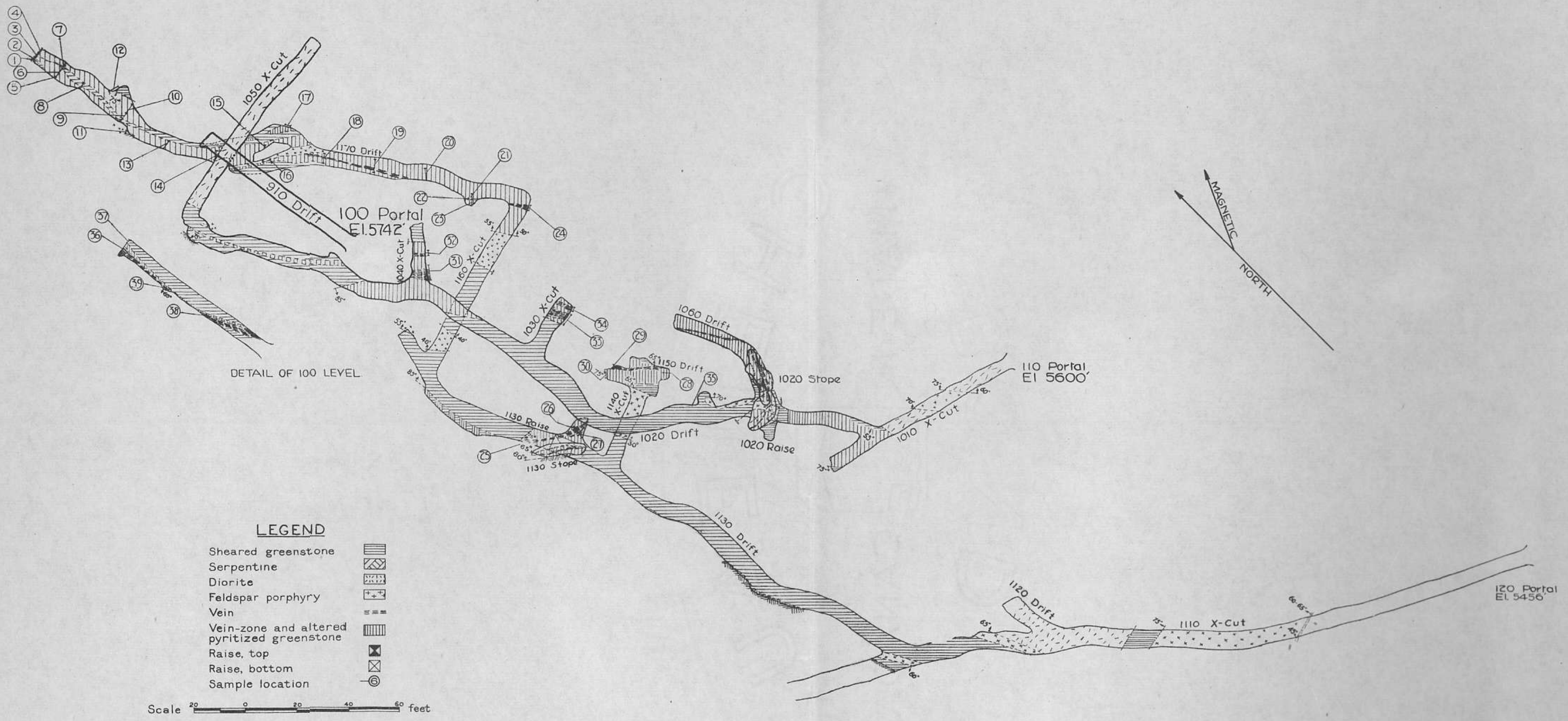

Fig. 4. Plan of underground workings Highland Surprise
based on company plan.

required to show whether the veins are merely shoots within the vein-zones or whether the veins are concentrations at the intersections of cross-fractures with the fractures of the vein-zones. The vein-zones strike north-westerly and dip northeastward or south-westward; indications are that any cross-fractures strike northerly or north-easterly. Sulphide mineralization within the veins consists of pyrite, chalcopyrite, and small amounts of galena and sphalerite. Pyrite is usually the only sulphide present in the vein-zones and in the wall-rock.

It is necessary to emphasize the extreme irregularity of the structure of the veins. Owing to the incompetency of the wall-rock, widths will pinch from mineable widths to a stringer within a few feet, and the dip will change as much as 90 degrees. At the same time, however, the occurrence of quartz will be maintained on the same general line of strike.

Geologic detail is given on Fig. 4. The small amount of information available makes correlation between exposures of rock-members or of vein-structure dangerous.

Development

Development consists of three adits at elevations of 5,472, 5,600 and 5,456 feet. These are known as the "100," "110," and "120" levels respectively. The "110" level was driven by the Consolidated Mining and Smelting Co. of Canada Ltd. in 1928 and 1929. The work of the Old Colony Trading Co. was centered on the "120" level. The "100" level was driven by the Highland Surprise Company in 1938.

The original surface exposure consisted of quartz up to 2 feet wide in sheared greenstone, close to the north-easterly contact of the serpentine at a location which is now between the portals of the "100" and "110" levels. This vein strikes north 25 degrees west, dips vertically and is mineralized sparsely with pyrite and chalcopyrite. The strike of the vein and direction of its outcrop are slightly farther west than that of the serpentine and greenstone contact. Both walls contain quartz and albite stringers and bunches for widths varying between 3 and 10 feet. The effect of the albitization is to give the rock a light-brown colour. Immediately to the north-east of the vein a feldspar-porphyry dyke, about 3 feet wide, nearly parallels it. From the lower, south-easterly end of the vein-exposure the outcrop is traceable for 150 feet to the north-west. In this length, the vein is sometimes represented by only a dissemination of quartz stringers marginal to which the albitization usually persists; at some locations vein-structure or stringers are, apparently, entirely absent but, on strike, reappear beyond such barrenness. At the south-easterly end of this surface exposure the "1020" stope breaks through. The vein changes strike abruptly to south 30 degrees west and this variation is one of the two occurrences on the property which suggests that there may be a north-easterly fracture-system although even at this point there is little or no direct evidence of the intersection of two fractures. At the north-westerly end of the surface exposure the "100" level has been driven on the vein. Beyond the portal of this level, to the north-west, outcrops of vein-quartz are present approximately on strike for a horizontal distance of 2,500 feet; the farthest north-westerly of these is well down the north-easterly wall of Whitewater Basin. This strike parallels the serpentine-greenstone contact. The outcrops are narrow, irregular, discontinuous and usually barren of sulphide mineralization or nearly so. It is not to be expected that development would prove maintained vein-structure over this entire length or even over any considerable part of it. However, as there is a recurrence of similar conditions to those just south-easterly from the "100" level, namely albitization, the presence of feldspar-porphyry dykes, approximate parallelism and nearness to the serpentine-greenstone contact, it appears reasonable to assume that, in this length, there may also be recurrence of commercial concentrations of gold-bearing sulphides in the quartz. Although it is probable that such concentrations are present in this length, present development underground on the property provides the only information as to whether they would be sufficiently frequent to permit any large-scale plan of underground development. Preliminary surface development might indicate isolated concentrations which could be mined as individual units.

From the portal of the "120" level, 1,200 feet south-easterly at an elevation of just under 5,000 feet, similar conditions of albitization in proximity to feldspar-porphyry dykes have been exposed by surface-cuts in greenstone close to the north-easterly contact of the serpentine. At the time of examination no vein-structure had been discovered although there was silicification and some pyritization of the greenstone near the albite stringers.

The "100" level drift was 69 feet long at the time of examination and provided a good exposure of vein-structure which strikes north 10 degrees west, and dips 65 degrees westward. The greenstone vein-walls, although probably not over 30 feet north-easterly from the serpentine contact, are strong and well maintained. On the walls of the vein and often frozen to them is a narrow band of albite; beyond this the greenstone walls have been highly altered for several feet, and are frequently well-mineralized with disseminated pyrite. The vein-quartz is compact and solid in the central width of 2 to 3 feet but is inclined to follow stringers into the walls. The best well-defined quartz-width is on the west wall of the drift; in places it is within the wall and is exposed by small side-swipes. Near the face an added width of poorly-mineralized quartz makes on the easterly side of the vein and at 69 feet from the portal, at the face, a sample was taken across 54 inches of vein-quartz. To the east of this sample there is an additional 2 feet of albitization and quartz stringers. Pyrite and chalcopyrite occur together in the vein but beyond its limits only pyrite is present.

From this level 103.93 tons of ore has been shipped which contained 94.10 oz. of gold and 71.74 oz. of silver, according to company's figures.

The "110" level was driven first as a crosscut for 80 feet slightly north of west, presumably to intersect the south-easterly extension of the surface outcrop. At 63 feet from the portal very narrow quartz stringers were exposed. These strike north 30 degrees west and were followed for 70 feet in that direction until they pinched and disappeared on the north-easterly wall. These are too narrow to be shown on Fig. 4. At 45 feet from the crosscut these stringers were well mineralized with pyrite and chalcopyrite and subsequent stoping and lateral development in "1020" stope and "1060" drift proved that the principal mineralization is in a quartz vein which strikes east, then north-east and finally north-westerly, and dips irregularly.

Figures supplied by the operators show that 121.41 tons of ore which contained 131.22 oz. of gold and 87.2 oz. of silver was mined from "1020" stope and from the surface close to the "break-through" from that stope.

Development in greenstone north-westerly from "1020" stope closely follows the contact of the serpentine. Cross-cuts "1030" and "1040" expose what is probably the extension of the vein in "1060" drift. In these crosscuts, however, the vein consists of considerable widths of low-grade, slightly-pyritized, highly-albitized quartz only. Beyond "1040" cross-cut the extension of the vein was intersected and drifted upon for 62 feet. In this length it should properly be termed a vein-zone as it is essentially a concentration of quartz and albite stringers only. Pyrite is present in only small amounts; hydrothermal alteration of included and adjacent wall-rock is marked. No further attempt was made to follow the zone when the serpentine was exposed on the westerly wall of the drift.

Crosscut "1050" was driven to intersect the projected upward extension of the zone exposed in "1170" drift on "120" level but, at the time of examination, the face was apparently still short of this objective. For practically its entire length this crosscut is in fine-grained, homogeneous diorite.

Details of development and geology on the "120" level are complete on Fig. 4 and need little explanation. The adit was driven first as a crosscut and was carried into the serpentine for a distance reported to be 80 feet. This work in the serpentine is now inaccessible. Encouraged by narrow and erratic quartz stringers close and parallel to the serpentine contact the adit was extended to the north-west. Irregular vein-quartz which contained considerable pyrite and chalcopyrite was exposed at 155 feet from the crosscut. Later this vein was stoped upward for 25 feet. This is "1130" stope. At 25 feet above the level the vein is cut off at the junction of the serpentine and the feldspar-porphyry dyke intersected in crosscut "1140". This crosscut was driven to develop any extension of the vein on the easterly side of the dyke. Vein-structure was found as indicated on Fig. 4. The vein contains good concentrations of pyrite and chalcopyrite over short lengths just to the north from the crosscut, but, development to the south from the crosscut showed the vein-quartz to be irregular and sulphide mineralization sparse. This drift, "1150", it is stated, has been carried southerly slightly farther than shown on Fig. 4, and a raise has also been carried upward for some 30 feet from a point in "1150" drift about 20 feet south of "1140" crosscut. This last work has been completed since examination was made, but it is understood that development from the top of the raise has disclosed vein-structure which strikes first north 70 degrees west and then almost due north. This development at the top of the raise lies to the west of "1150" drift and thus the vein (or veins) is close to the hanging-wall of the feldspar-porphyry dyke and probably represents the extension of the vein in "1130" stope. Possibly this exposure is the second of the two occurrences which may provide information regarding cross-fracturing of the main vein-zone system. The other is in "1020" stope and there may be some relation between the two but present development does not permit any such correlation.

Company figures show that, up to August 26th, 1939, a total of 102.4 tons of ore containing 83.80 oz. of gold and 78.9 oz. of silver has been shipped from "1130" stope and from "1150" drift.

The westerly of two feldspar-porphyry dykes intersected in crosscut "1160" may be the same dyke as the one exposed in

"1140" crosscut. Adjacent to this dyke in "1160" crosscut there is little or no pyritization, and no vein-structure. On the westerly side of the easterly dyke in "1160" crosscut there is a 2- to 3-foot width of quartz which contains bunchy concentrations of pyrite. This is included within the limits of the dyke, and suggests absorption of an earlier vein.

Drift "1170" followed a vein-zone which is composed of typical quartz and albite stringers. The intersection of the "1170" drift and the "1160" crosscut exposes from 2 to 4 feet of barren quartz which stands almost vertically. However, the zone is represented by this quartz-width only at the south end of the drift. A feldspar-porphyry dyke is exposed intermittently by the drift, and is apparently related closely to the vein-zone. The dyke, the vein-zone and the occasional widths of solid quartz are mineralized sparsely with pyrite. In this drift sufficient samples were taken to permit an estimate of average values.

Sampling

When the samples were taken an effort was made to separate the various rock- and vein-types. In the following table the term "dark greenstone" is used to identify the greenstone, marginal to the veins and vein-zones, which has been so affected by hydrothermal alteration that it is now almost black. However, as this is also the typical host-rock for the quartz and albite stringers, which comprise the vein-zones, it was sometimes difficult to define the exact margins of the vein-zones.

Sample-locations are shown on Fig. 4; assays are as follows:

Sample Number	Width	Gold	Silver	Remarks
	Inches	Oz. per ton	Oz. per ton	
1	10	trace	trace	Feldspar-porphyry dyke, slightly pyritized.
2	12	trace	trace	Hanging-wall greenstone.
3	32	0.07	0.4	Vein-zone, slightly pyritized.
4	46	0.03	trace	Dark greenstone, slightly pyritized.

Sample Number	Width	Gold	Silver	Remarks
	Inches	Oz. per ton	Oz. per ton	
5	2	trace	trace	Hanging-wall greenstone including pyrite stringer.
6	57	0.02	trace	Vein-zone, slightly pyritized.
7	21	0.02	trace	Dark greenstone, slightly pyritized.
8	25	0.12	0.2	Vein-zone, large proportion of quartz, slightly pyritized.
9	45	0.02	trace	Includes 12 inches vein-zone, slightly pyritized; 12 inches hanging-wall greenstone, barren; 21 inches dark greenstone, slightly pyritized on foot-wall; true vein-zone.
10	56	trace	trace	Dark greenstone, contains considerable quartz.
11	14	0.02	1.2	Feldspar-porphyry dyke, slightly pyritized.
12	49	trace	trace	Dark greenstone, contains quartz stringers, slightly pyritized.
13	46	0.04	trace	Vein-zone, little sulphide.
14	55	0.04	trace	Vein-zone, little sulphide.
15	14	0.10	trace	Vein-zone, little sulphide.
16	20	trace	trace	Vein-zone, little sulphide.
17	26	trace	trace	Dark greenstone, contains bunchy quartz, a little pyrite.

Sample Number	Width	Gold	Silver	Remarks
	Inches	Oz. per ton	Oz. per ton	
18	48	0.04	trace	Vein-zone, including 12-inch quartz band.
19	57	0.10	trace	Vein-zone, including 12-inch quartz band.
20	53	0.04	trace	Vein-zone, here represented mainly by dark homogeneous greenstone.
21	17	0.16	0.1	Dark greenstone, slightly pyritized.
22	$3\frac{1}{2}$	0.30	0.1	Quartz stringer, very little sulphide.
23	41	0.04	trace	Vein-zone.
24	25	0.02	trace	Quartz, little sulphide.
25	14	1.04	0.6	Across two quartz stringers, respectively 4 and 5 inches wide and 5 inches dark greenstone between them. Stringers contain considerable pyrite, some chalcopyrite.
26	34	0.80	1.2	Across bunchy concentration quartz which contains considerable pyrite.
27	32	0.12	0.2	Across irregular quartz stringers in dark greenstone. Stringers pyritized slightly.

Sample Number	Width	Gold	Silver	Remarks
	Inches	Oz. per ton	Oz. per ton	
28	53	0.03	trace	Dark greenstone, vein represented by only few narrow stringers, very slightly pyritized
29	22	0.02	0.6	Vein-quartz, considerable pyrite.
30	39	0.02	trace	Dark greenstone, very slightly pyritized.
31	56	0.18	0.1	Vein-quartz, slightly pyritized.
32	21	0.12	trace	Vein-quartz, slightly pyritized.
33	69	0.08	trace	Vein-quartz, inclusions albite and country rock, slightly pyritized.
34	21	0.18	0.1	As sample No. 33.
35	4	trace	trace	Quartz, no sulphide.
36	54	0.22	0.4	Vein-quartz, sparse pyrite, chalcopyrite.
37	22	0.02	trace	Dark greenstone, albite stringers, quartz stringers, slightly pyritized.
38	12	0.36	0.4	Vein-quartz, considerable pyrite, chalcopyrite.
39	10	0.50	0.4	As sample No. 38.

GOLD QUARTZ GROUP. This group consists of the Gold Quartz, the Gold Quartz Nos. 1 to 9 mineral claims, the Cotton Tail, and Cotton Tail Nos. 1 and 2 fractional mineral claims, all held by right of location by Joe Gallo of Nelson, B. C. These claims cover most of Whitewater Basin and its flanks, and a considerable length along the projected strike of the Highland Surprise occurrence.

Information relative to access, topography and general geology are included in the foregoing general statement on the district.

The principal development has been on the north-easterly side of the basin, about one-third of the way up from its south-easterly end, at elevations between 6,000 and 7,000 feet. The location is shown on Fig. 3. As at the Highland Surprise, the veins exposed here are in greenstone on the north-easterly side but farther away from the serpentine contact. Probably as a result of the greater distance from the serpentine contact the greenstone, in which the Gold Quartz veins occur, is generally more massive and compact than that exposed underground at the Highland Surprise. Although the greenstone-serpentine contact is covered with overburden toward the easterly end of Whitewater Basin, it may be placed approximately as on Fig. 3. The greenstone, near the vein-exposures, is intruded by irregular masses of diorite and by feldspar-porphyry dykes. The veins upon which development has been concentrated strike north-westerly. Thus, rock-types, and the strike of the veins at the Gold Quartz, duplicate conditions at the Highland Surprise. There are, however, two marked points of difference between the two deposits. One is that there are conspicuous amounts of galena and sphalerite with the pyrite and chalcopyrite in the Gold Quartz veins. The second difference is that at the Gold Quartz there are exposed at least three narrow quartz veins which strike north-east or easterly. Practically no work has been done on these veins but they may be of importance as indicators of fractures which intersect the principal fracture-system of north-westerly strike.

Development

At an elevation of 6,300 feet, surface-stripping has exposed a vein over a length of 200 feet, which strikes north 20 to 25 degrees west, and dips 60 to 70 degrees eastward. There are usually one or two well-maintained bands of quartz which vary in width from 6 to 24 inches. Between these bands, also outside them, quartz stringers occur irregularly in the greenstone. Sulphides are disseminated in the quartz and in the greenstone, and the total width of the lode varies from 24 to 84 inches. Within some of the wider bands of quartz are longitudinal openings, the walls of which are coated with milky, crystalline quartz. This evidence, with conspicuous amounts of galena and sphalerite in the vein, suggests there may be some correlation between the present surface and temperature-conditions which prevailed at the time of vein-deposition. No such open structure, and little or no galena or sphalerite, is present in the veins exposed at the <u>Highland Surprise</u> where the upper adit is 600 to 1,300 feet lower than the <u>Gold Quartz</u> exposures. Just south-easterly of the

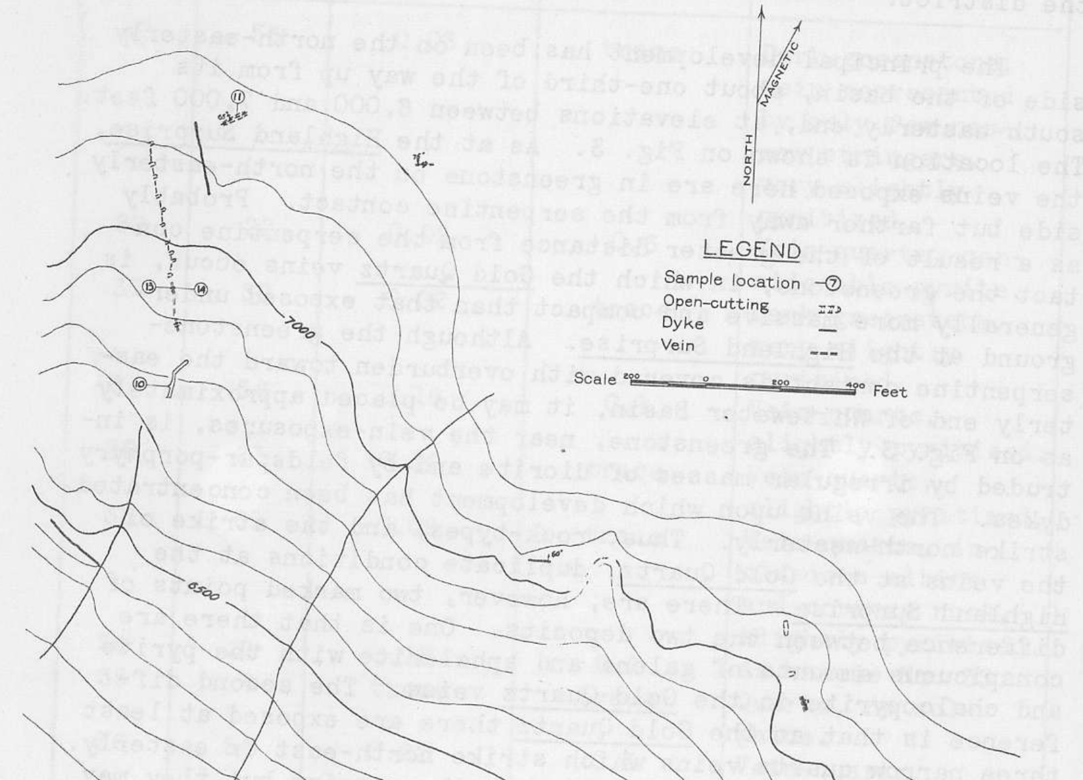

Fig. 5. Showings and sample locations on the Gold Quartz group.

line of open-cuts a short adit, driven north 65 degrees east, exposes quartz stringers which have a general strike of north 30 degrees west. These may be the only evidence of the vein-structure at this location although there is a possibility that the face is not sufficiently far advanced to expose all the vein-structure. At the creek the greenstone on the foot-wall of the vein is heavily sheared. The planes of shearing strike north 35 to 55 degrees west, and dip 50 to 70 degrees south-westward. The greenstone on the hanging-wall of the vein has also been sheared, and more ferro-magnesian minerals are present than in the greenstone on the foot-wall. The rock may originally have been diorite.

All sample locations are shown on Fig. 5. Four samples were taken from this exposure, as follows:

1. Across 76 inches, which included 36 inches of solid quartz at the centre, 12 inches of solid quartz on the foot-wall-side, and small amounts of pyrite and chalcopyrite, assayed: Gold, trace; silver, 0.6 oz. per ton.

2. Across 96 inches of quartz stringers and altered greenstone. Small amounts of pyrite and chalcopyrite, assayed: Gold, 0.04 oz. per ton; silver, 0.5 oz. per ton.

3. Across 28 inches of solid quartz which contains narrow bands of massive pyrite and chalcopyrite with small amounts of galena and sphalerite, assayed: Gold, 0.10 oz. per ton; silver, 0.7 oz. per ton.

4. Select sulphide mineralization from small ore-pile from this cut; considerable pyrite, chalcopyrite, galena and sphalerite, assayed: Gold, 0.32 oz. per ton; silver, 4.5 oz. per ton.

A second vein is exposed 650 feet north-easterly from this vein, at an elevation of 6,700 feet. This vein strikes north 35 degrees west, dips 75 degrees north-eastward and is traced by cuts over a length of 600 feet.

The rocks are massive and sheared greenstones intruded by diorite and feldspar-porphyry dykes. The diorite is well-exposed; for part of its length the vein occurs in diorite. A feldspar-porphyry dyke is on the hangingwall-side of the vein for most of the 600-foot length exposed. This dyke is 2 to 3 feet wide, grey when freshly-fractured and white or pink when weathered. Fractures in the dyke which are filled with vein-quartz indicate that the dyke is older than the vein.

In the length exposed the width of the vein varies between 4 inches and 48 inches. Pyrite, chalcopyrite, sphalerite and galena are disseminated sparsely in the quartz-gangue. In the narrower widths the vein consists of one width of quartz; in the wider sections, it is often made up of several central bands and irregular marginal stringers of quartz, and there is some albitization.

Samples taken from this vein were assayed as follows:

5. Across 4 inches of quartz, full vein-width, which contained a very small amount of pyrite. Gold, trace; silver, trace.

6. Across 31 inches of quartz which contained a very slight amount of pyrite. This sample was taken 20 feet south-easterly from the portal of a short drift-adit. Gold, trace; silver, 0.2 oz. per ton.

7. Across 15 inches of vein-quartz, barren of sulphides, at face of 20-foot drift-adit. Gold, nil; silver, nil.

8. Select sulphide mineralization from 20-foot drift-adit containing a considerable amount of pyrite, chalcopyrite, slight galena and sphalerite, assayed: Gold, 0.46 oz. per ton; silver, 4.5 oz. per ton.

About 800 feet westerly from this vein-exposure, at an elevation of 6,425 feet, a drift-adit has been driven on a vein which strikes north 85 degrees west and dips vertically. In compact greenstone, and between 1 and 2 feet wide, this vein is strong and well-defined. The quartz-gangue is blue in colour; sulphide mineralization is principally pyrite, with small amounts of chalcopyrite. One sample, No. 9, taken at the face, across the full vein-width of 21 inches, containing but little sulphide, assayed: Gold, 0.02 oz. per ton; silver, 0.2 oz. per ton.

Approximately 2,000 feet north-westerly from this adit, at elevations between 6,800 and 7,300 feet, development has been done on a series of quartz veins and stringers. In this area the rocks exposed are massive and sheared greenstones, intruded by diorite and feldspar-porphyry dykes and the relations between the various members are well-exposed. Rock-surfaces have been smoothed and rounded by the passage of ice, and glacial striae are well-developed.

At an elevation of 6,770 feet a zone of quartz stringers is exposed in greenstone which is sheared along planes that strike north 50 degrees west and dip 60 degrees south-westward. The greenstone is highly chloritized, and in the vicinity of the stringer-zone hydrothermal effects have produced typical darkening of its colour. A series of strong joints strike north 55 degrees east and dip 80 degrees south-eastward. The stringer-zone strikes generally slightly east of north. On its westerly margin there is one strand of quartz which strikes north 20 degrees east and contains a little pyrite and chalcopyrite. The stringers to the east of this width trend farther easterly and many of them follow the jointing. The total width of the zone is as much as 30 feet and slight pyritization is general.

A drift has been driven for 120 feet on the westerly quartz strand and exposes it as typically irregular in strike and width. The strike is irregular because of a tendency for the quartz to be offset and change direction at intersections with the joints. The width is irregular on account of bunchiness which occurs at these intersections. Under these conditions it is difficult to estimate an average width for the vein but it is doubtful if it is over 1 foot. At 24 feet inside the portal a branch-stringer, strike north 5 degrees west, dip irregular, has been followed by a short drift and is shown to consist of strong, blue quartz which carries bunches of pyrite and chalcopyrite. A sample of this stringer, No. 10, taken at its intersection with the main quartz strand, across 6 inches, assayed: Gold, 0.08 oz. per ton; silver, 0.5 oz. per ton.

North of this adit a line of open-cuts exposes quartz mineralization which may be the upward extension of that found in the adit. The quartz occurs in schistose greenstone along the shear-zones which strike north 20 degrees west and dip steeply south-westward.

Immediately to the east of the open-cuts there is a mass of diorite the westerly contact of which, apparently, parallels the strike of the quartz and the shearing in the greenstone. The two most southerly open-cuts expose from 5- to 10-foot widths of slightly-pyritized quartz. Samples Nos. 13 and 14 were taken across the total width. No. 13, across 57 inches, assayed: Gold, 0.20 oz. per ton; silver, trace. No. 14, across 72 inches assayed: Gold, trace; silver, 0.2 oz. per ton. The remainder of the cuts to the north expose indefinite quartz stringers and, in one place, a considerable width of barren quartz and calcite.

To the east the diorite extends for several hundred feet but its margin in that direction is obscured and complicated by inclusions of greenstone. A strong feldspar-porphyry dyke lies in the diorite, and is well-exposed for a length of 200 feet. As shown on Fig. 3 this dyke has approximately the same strike as the westerly margin of the diorite and the quartz-zone. Seventy feet easterly from the dyke a vein from 6 to 8 inches wide, strike north 65 degrees east, dip 65 degrees north-westward, is exposed in greenstone. Sample No. 11, taken across 6 inches of quartz which contained very little sulphide, assayed: Gold, 0.08 oz. per ton; silver, 0.5 oz. per ton. A select sample of sulphide mineralization, which contained chal-copyrite and small amounts of pyrite, assayed: Gold, 0.10 oz. per ton; silver, 0.9 oz. per ton.

To the east of this exposure two stringers outcrop, and one of them may be the extension of this vein. Insufficient development-work has been done to prove this.

EUREKA GROUP. This group includes the Gap, Faith, Hope, Charity, Little Winnie, Agnes, Lillian, G. Hyde, Butte and Anaconda mineral claims, held by right of location. The property is under option to the Commodore Mining Co. represented by Roy Wallace of Walla Walla, Wash. The camp, which consists of one cabin, is located on the south-east side of Lyle Creek Basin at an elevation of 5,950 feet. Access is by 2 miles of road and 1 mile of trail from the Lyle Creek Basin road; the Eureka group road leaves the Lyle Creek road at a distance of 2 1/2 miles from Retallack. At the camp the wall of Lyle Creek Basin drops away steeply to the north-west; higher ground lies to the north-east. There is no adequate water-supply near the camp and domestic water is at present obtained underground.

The property was developed originally in the course of exploration for lead-silver ore. This early work was done on the higher ground to the north-east of the present camp. Discovery of gold values in a quartz vein led to the more recent development.

The camp is located on the serpentine; a short distance northerly from the camp the gold-quartz vein is exposed on the surface at an elevation of 6,320 feet, on the north-easterly contact of the serpentine. Where examined on the surface the vein is 2 to 3 feet wide, consists of quartz which contains no visible sulphides, strikes north 30 degrees west and stands almost vertical. It is claimed that the outcrop can be traced farther to the north-west.

An adit has been driven below the surface outcrop, at an elevation of 6,000 feet, and 350 feet north 10 degrees west from the camp. The portal is in the diorite about 200 feet north of the serpentine contact. The adit was driven for 290 feet in a semi-circular direction; commencing on a bearing north 25 degrees east, and finally bearing south 85 degrees west. This part of the development, known as a crosscut, is in diorite.

At 244 feet from the portal a narrow shear-zone was intersected which strikes north 8 degrees west and dips 55 to 70 degrees westward. Irregular quartz stringers follow the shear-planes. A feldspar-porphyry dyke which is exposed on the north wall of the crosscut strikes north 60 degrees west and dips 70 degrees south-westward. A younger more siliceous dyke, frequently intruding the older one, closely follows it. The dykes are intersected by the shear-zone and a drift driven northerly on the shear exposes the faulted extensions of the dykes a few feet from the crosscut. The drift on the shear-zone extends from the crosscut for 304 feet in a direction generally north-westerly. In this length the shear-zone persists, and quartz stringers, and narrow bands are usually present somewhere within its widths. In some sections the shear is as much as 8 feet wide. The quartz stringers are frequently concentrated within widths up to 3 feet. The wall-rock is heavily sheared and altered and it appears probable that the silicified shear-zone is closely related to a diorite-greenstone contact. At 158 to 197 feet from the crosscut a stope has been carried 10 feet above the back of the drift as development on a 3- to 6-inch quartz-band within the stringer-zone. The dip of the zone is 70 to 75 degrees south-westward. A sample taken across this band, 3 1/2 inches wide, at the back of the stope, assayed: Gold, 1.2 oz. per ton; silver, 0.5 oz. per ton. At this location there was considerable pyrite and chalcopyrite in the quartz. The wall-rock in the stope is schist, containing quartz stringers in which there is little or no sulphide. A sample taken on the hangingwall-side of the previous sample, over 24 inches, assayed: Gold, trace; silver, trace. At 234 feet from the main adit a short crosscut to the north-east provides a good exposure of the shear-zone. Irregular quartz stringers are distributed across the full width of this shear-zone but sulphide mineralization is sparse. A sample taken in the crosscut, across 7 feet, assayed: Gold, 0.22 oz. per ton; silver, trace. The drift follows the shear to the face at 304 feet from the crosscut.

<u>Conclusions Regarding the Lyle Creek-Whitewater Creek Area</u>

The area is of interest by reason of the attractive gold values which have been proved to date but further extensive development is required to ascertain a system of localization for these values and the extent of gold-concentration in such a system. Thus further prospecting, surface or underground, should be conducted primarily to ascertain the pattern of ore-shoots in the vein-system. Some specific suggestions for the direction of planned development are contained in the following: (1) Notably, that the veins on the north-easterly margin of the serpentine appear more attractive than those on the south-westerly. (2) That there may be some intersections of the north-westerly fracture-system by secondary fractures to produce conditions favourable to the deposition of ore.