

PART B

ANNUAL REPORT
OF THE
MINISTER OF MINES

OF THE PROVINCE OF

BRITISH COLUMBIA

FOR THE

YEAR ENDED 31ST DECEMBER

1936



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BRITISH COLUMBIA DEPARTMENT OF MINES.
VICTORIA, B.C.

Hon. GEORGE S. PEARSON, *Minister.*

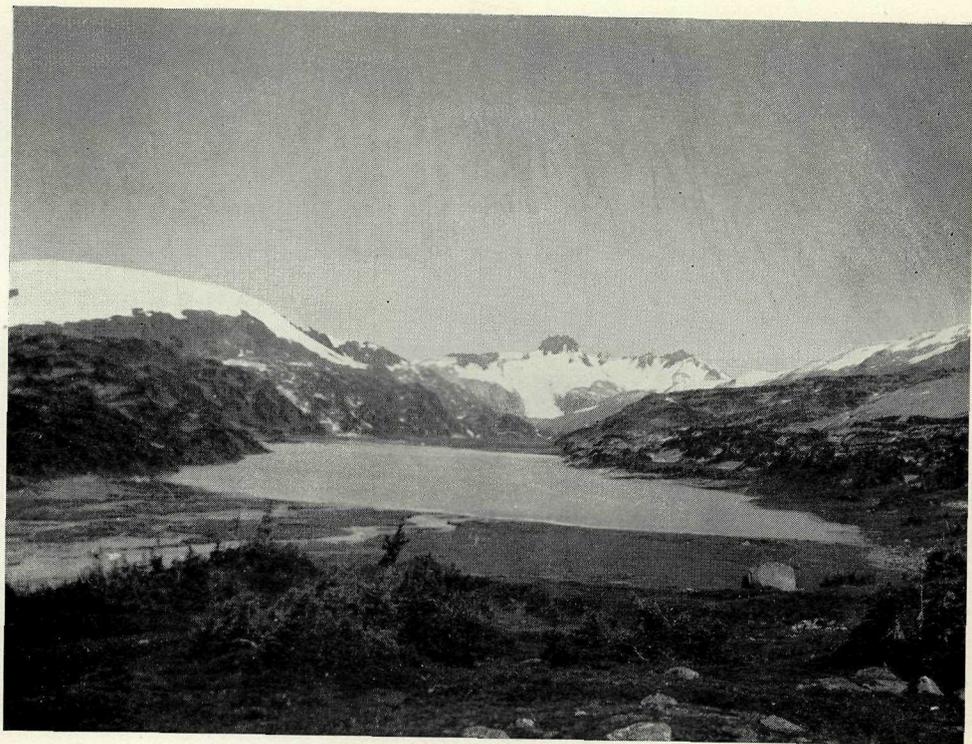
JOHN F. WALKER, *Deputy Minister and Provincial Mineralogist.*

JAMES DICKSON, *Chief Inspector of Mines.*

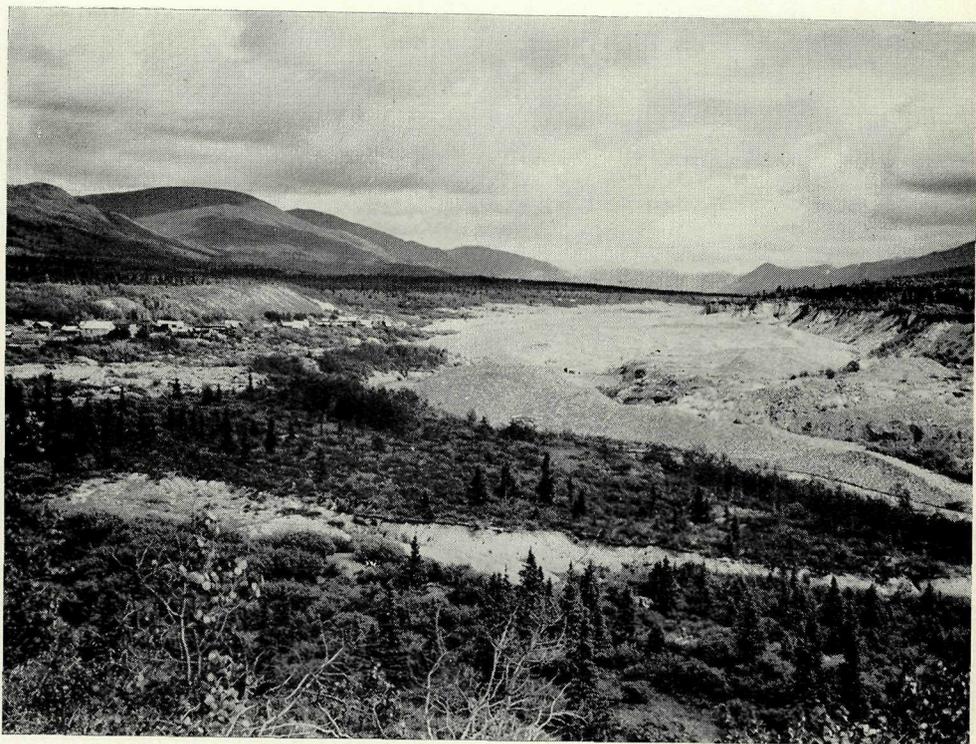
D. E. WHITTAKER, *Provincial Assayer and Analyst.*

P. B. FREELAND, *Chief Mining Engineer.,*

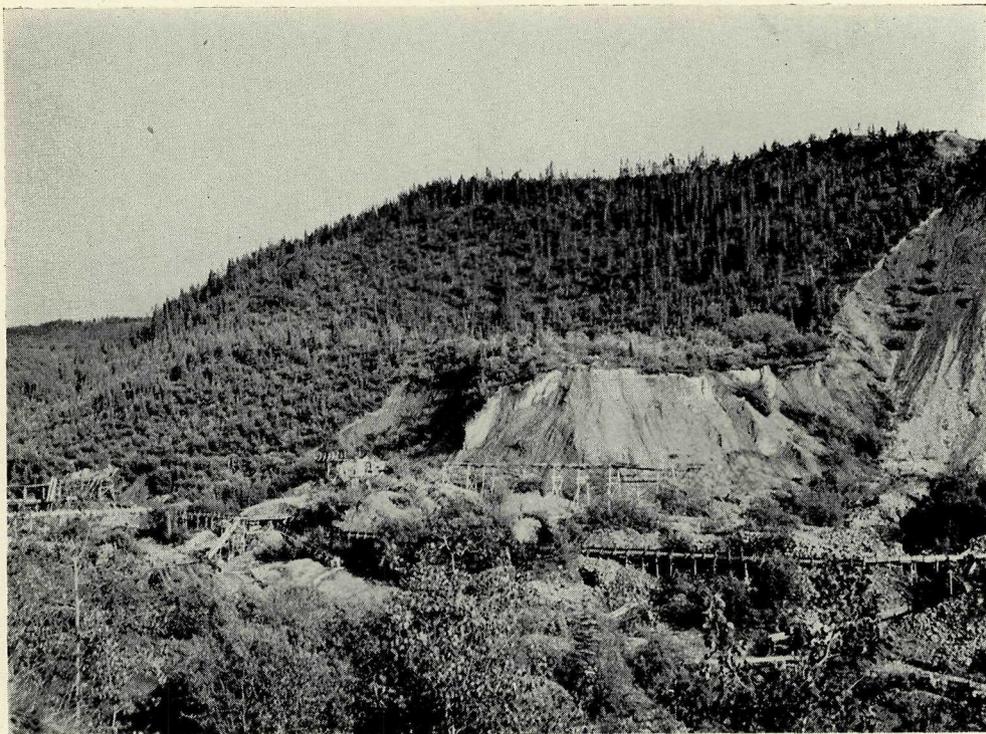
R. J. STEENSON, *Chief Gold Commissioner.*



Cascade Creek Area, Stewart—looking North to Long Lake and Outre Mountain.



Pine Creek, Atlin—looking up Pine Creek from about its Centre, at One-half Mile below Pine City.



Lower Spruce Creek, Atlin. Drift-workings on Jewell and St. Quentin Leases at Lower End of Old Channel. The Old Channel is hanging at this Point,



Spruce Creek, Atlin—looking up Creek from Road above Right Bank. Olalla Lease and Columbia Development Co.'s Upper Steam-shovel. From Right Rim of Old Channel.

PART B.
NORTH-WESTERN MINERAL SURVEY DISTRICT (No. 1).

BY

JOSEPH T. MANDY.

SUMMARY.

The interest in gold-mining, so evident in this district in 1935, has continued unabated throughout 1936. This has led to preparations for production at the *Big Missouri*, operated by Buena Vista Mining Company, which is controlled by Consolidated Mining and Smelting Company of Canada, and at the B.C. Silver and Sebakwe properties, now consolidated with the Premier mine through incorporation of Silbak-Premier Mines, Limited. In the late summer it was announced that *Big Missouri* would be brought into production with a milling capacity of 750 tons daily. Construction-work on necessary road and power-plant requirements, together with excavation for the mill-site, which is to be underground, was commenced in August. Production from this property may be inaugurated about the autumn of 1937.

Normal production has continued from *Premier* mine, Stewart, a feature of which operation has been the bulk-blasting of a block of about 65,000 tons of ore from pillars between No. 1 and No. 2 levels. With gradual depletion of ore reserves in this mine, diminishing production will be gradually merged with that from *B.C. Silver* and *Sebakwe* under Silbak-Premier Company operation. This operation assures appreciably extended life and utility to the Premier mine organization and plant. Continued favourable development of the *Whitewater* property, Taku River, operated by the Edward C. Congdon interests of Duluth, Minnesota, indicates possible mill-construction and production from this property during 1937. *Surf Point* mine, Porcher Island, operated by N. A. Timmins corporation, has maintained normal production and indicated ore reserves have been increased. Production from *Dunwell*, Stewart, continued from early spring to late December, with operation of the mine and mill by Welldun Mining, Milling, and Power Company, under a leasing agreement with Dunwell Mines, Limited. With completion of the 25-ton-capacity mill at Esperanza Mines, Limited, Alice Arm, production commenced at the end of July. Increased mill production is reported from the Surf Inlet Consolidated operation, Princess Royal Island. A 40-ton New Hadsel mill has been installed at the *Skidegate-Southeaster* property, Graham Island, Queen Charlotte Islands, and production commenced in the late autumn. Construction of a small-capacity mill at *Helena Gold Mines* property, Georgia River, Portland Canal, was also commenced in the late autumn and production from this property may materialize during 1937. Small shipments have been made from the *Lakeview*, *Ketchum* ("Ontario Mine"), *United Empire*, and *Parvati* properties, Stewart; the *Dolly Varden*, Alice Arm; and the *Edye Pass* group, Porcher Island. Small shipments of fine-grained mica have also been made from the *Sericite* group, Baker Inlet.

Although major silver operations remain curtailed, shipments of high-grade silver ores and concentrates from several small operations in the Alice Arm and Portland Canal areas have been made. A gradual expansion of silver-mining under sound financial and technical organization is indicated.

Placer-gold production value shows an increase mainly on account of increasing large-scale operation in the Atlin area. Due to this factor, also to known and projected placer-gold potentialities of the Atlin Camp, indicated by field-work during 1936, the outlook for sustained and increasing future placer-gold production is bright.

The closing of the Granby Consolidated operation at Anyox has adversely affected lode-production value for 1936. Increased gold production will partially offset this loss and indications are that it will be compensated in the near future.

Active exploration was carried out by companies on several lode properties throughout the district. These included the *Big Missouri*, *Hercules*, *Salmon Gold*, *B.C. Silver*, *Sebakwe*, *United Empire*, *Oral M.*, and *Red Reef* groups in the Stewart section; the Mackay Syndicate, Unuk Valley Gold Syndicate, and Unuk River Placers properties in the Unuk River section; and the *Whitewater* group, Taku River. On the *Edye Pass* group on Porcher Island, the Reward Mining

Company initiated intensive exploratory development-work which it is planned to continue throughout the winter. In the Queen Charlotte Islands exploratory development was continued on the *Skidegate-Southeaster* and a limited amount carried out on the *Haida Gold*. Besides these operations, exploratory work by individual prospectors was carried out on many properties throughout the district.

Placer-gold mining and prospecting by individuals, syndicates, and companies has been very active in the Dease and Liard areas, and especially in the Atlin Division, where about 160 operations of various extent have proceeded.

Prospecting shows an increase over 1935 throughout the district. New discoveries of importance have been made in the Portland Canal and Atlin Divisions. In the Table Mountain section, McDame Creek area, Liard Division, a lode-gold discovery of interest on the *Vollaug* group has been optioned by Consolidated Mining and Smelting Company of Canada. Further exploration of this showing is planned for the 1937 season.

The year 1936 has been one of the most active and progressive in the mining history of this district.

The writer desires to express his thanks to prospectors, operators, and all those with whom he has come in contact during the conduct of his work, for their co-operation.

LODE-GOLD DEPOSITS.

PORTLAND CANAL AREA.

Helena Gold Mines, Ltd. This company was incorporated in 1933, with an authorized capital structure of 2,000,000 shares of \$1 par value, to acquire title and assets of Georgia River Gold Mines, Limited. In this reorganization the Georgia River Company received 800,000 Helena Gold Mines shares. Of these, the Georgia River shareholders received 750,000 shares on the basis of four old shares for one new, and 50,000 shares were set aside to cover liquidation expenses. Wellington Beaton is president and general manager and the registered office of the company is 901 Credit Foncier Building, 850 Hastings Street West, Vancouver.

In 1935, Gold Leasers, Limited, a private company, with an authorized capital of \$25,000, made up of 2,000 Class A and 500 Class B shares, both of \$10 par value, was formed for the purpose of leasing the property of Georgia River Gold Mines, Limited, from Helena Gold Mines, Limited, to December 31st, 1937. This agreement required Gold Leasers, Limited, to build a mill of not less than 10 tons daily capacity which was to become the property of the company at the termination of the lease. Gold Leasers, Limited, capital was later increased by \$35,000 to a total of \$60,000, a portion of which is to be sold to secure capital for construction of the mill. The executive offices of Gold Leasers, Limited, is at 902 Credit Foncier Building, Vancouver.

The property is composed of thirty-four Crown-granted mineral claims and fractions, about 1,227 acres, and is located in the Colling Range on the east side of Portland Canal, in the Portland Canal Mining Division, about 18 miles south of the village of Stewart and about 8 miles by trail from seaboard at the mouth of Georgia River.

The property is reached by launch from Stewart to the beach camp at the mouth of Georgia River, a distance of about 18 miles. From thence a pack-horse trail extends for about 6½ miles up the Georgia River Valley to the Cache Camp, elevation 1,225 feet, at the foot of the mountain. About 2½ miles of this stretch of the trail is puncheoned through muskeg, and to be efficient for pack-horse traffic additional stretches still require puncheoning. Along one or two short stretches of the first 5 miles the trail is narrow around steep rock hill-slopes. Between the beach and the Cache Camp several small streams are crossed by culverts and the Georgia River is crossed at about 1 mile and 5½ miles from the Beach Camp by bridges about 100 feet long. At the Cache the Georgia River is again crossed and the trail follows a circuitous and steep route for about 1½ miles to the mine camp at elevation 3,300 feet. Along the last mile of this stretch the trail is poorly located and follows a very steep grade requiring extensive rock-work in places.

The mineral deposits were discovered and staked in 1910 by Danny Hume, of Stewart. The Georgia River Gold Mines, Limited, was incorporated in 1925 with an authorized capital of \$1,000,000, later increased to \$3,000,000. Up to 1932 operations were conducted by the

Georgia River Company. Helena Gold Mines took over operation in 1933 and ceased in 1934. In 1935 a limited amount of mining-work was done by Gold Leasers, Limited, between August and December of that year. In the spring of 1936, lumber for mill-construction, and oil-supply, was packed in and in the late fall the mill building was constructed. No mining was done during 1936. (Annual Reports of the Minister of Mines for the years 1910 to 1912, 1914 to 1918, 1922 to 1924, 1928 to 1930, 1932, 1933, and Bulletin No. 1, 1932, "Lode-gold Deposits of British Columbia.")

The topography of the area incorporates the characteristic ruggedness of the Coast Mountains, of which the Colling Range is a local segment. The deep valley of Georgia River is bordered by steep and extensively bluffed slopes, generally heavily timbered with mainly spruce, hemlock, and cedar and thickly covered with underbrush. Timber-line is at about 3,200 feet altitude, and above this grassy slopes of more subdued inclination extend to the bluffed and domed ridges of the range-crest at between 5,000 and 6,000 feet elevation.

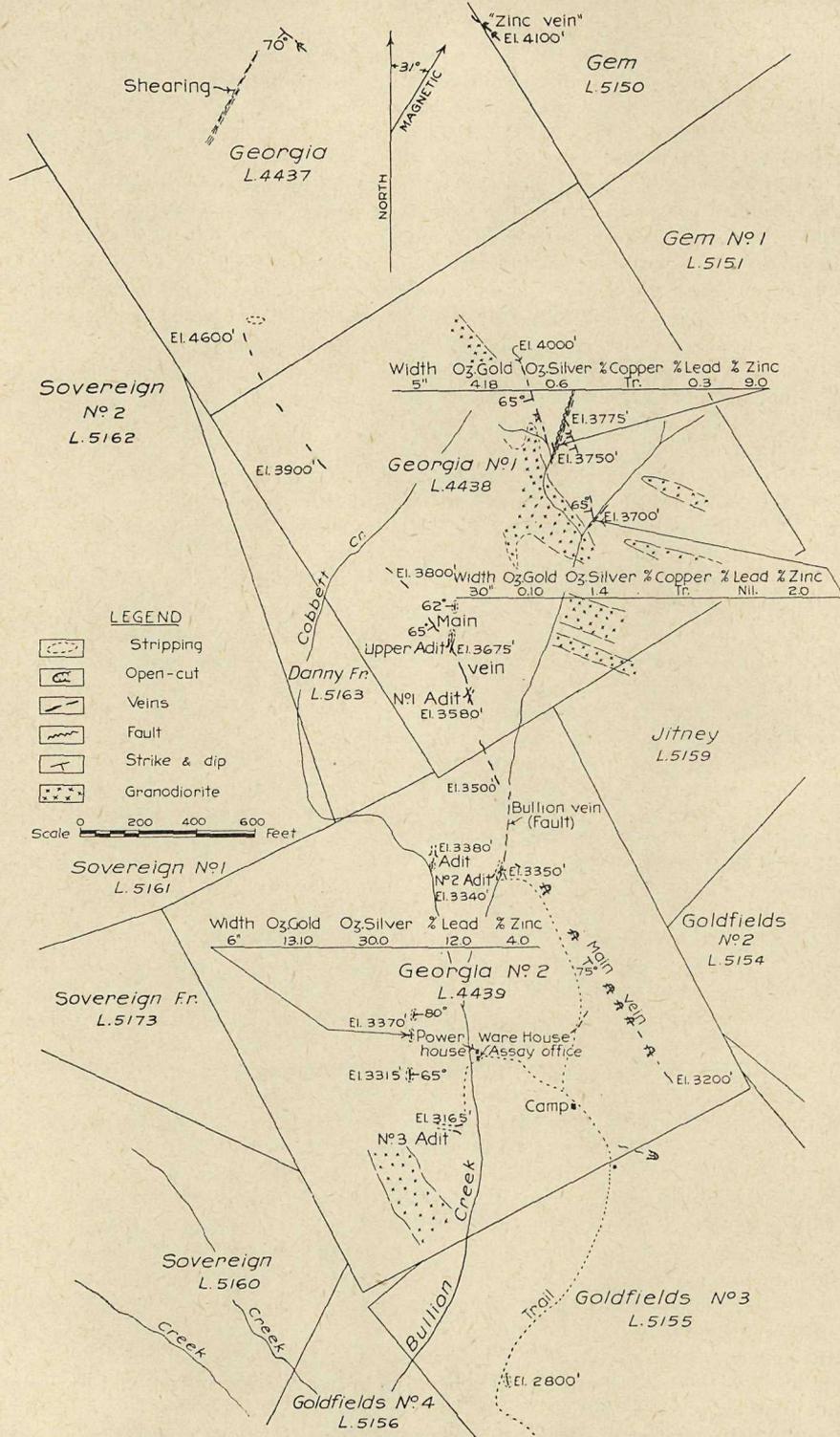
The rocks underlying the area consist chiefly of altered crystalline andesitic flows (greenstone) and altered, probably tuffaceous, sediments. These rocks have been subjected locally to strong shearing movements and are altered to mica-schists, especially in the vicinity of major, north-striking fault-zones. This formation can be correlated with the Bear River series (Hazelton group) of probably lower to middle Jurassic age. Granitic dykes and tongues intrude this series of rocks extensively in the locality of the workings and showings. Structurally, the series in this locality comprises a triangular pendant-inclusion, about 12 miles wide along Portland Canal and extending for 13 miles eastward towards the head of Hastings Arm, lying within and contiguous to the eastern contact of the Coast Range granodiorite batholith. The intrusive granitic dykes and tongues are satellitic to the underlying batholith.

The known mineral deposits are located between elevations of 2,800 and 4,600 feet around the central section and head of Bullion Creek. Bullion Creek in its headwaters section, which is the locality of the main workings, occupies a major fault-structure striking north 9 degrees east and dipping vertically and known as the "Bullion" vein. Striking at various angles between north and north-west towards and across the "Bullion" fault and dipping generally steeply west, a series of quartz-filled fractures occurs. The typical transverse veins vary in width from a few inches to about 4 feet. In the case of the "Main" vein, which differs in character from the smaller veins and resembles a quartz-replacement body, widths from 5 to about 20 feet are exposed. The transverse veins and the "Bullion" vein are locally well mineralized along short stretches with pyrrhotite, pyrite, sphalerite, galena, and some arsenopyrite. The "Main" vein is generally very sparsely mineralized chiefly with pyrrhotite. The best mineralization occurs at and around intersections of the transverse veins with the "Bullion" fault or with each other.

At elevation 2,800 feet, close to the trail and about half a mile from the camp, a quartz vein 10 to 18 inches wide has been exposed in a trench 3 feet deep and 30 feet long through clay overburden on the crest of the steep slope to Bullion Creek. This vein is mineralized in places with pyrite, galena, and sphalerite and should be traced to its possible intersection with the Bullion Creek fault.

The "Main" vein on the east side of Bullion Creek is traced along the 10-degree hill-slope, between elevation 3,200 and 3,350 feet in a north-westerly direction for 950 feet by natural exposure and a series of six open-cuts, showing generally barren quartz across widths of 4 to 8 feet. The vein is not continuous to or across Bullion Creek but is apparently faulted by the "Bullion" fault. On the west side of Bullion Creek the "Main" vein offset to the north about 200 feet is again naturally exposed along a distance of about 800 feet, with widths from 6 to 20 feet, between elevation 3,500 and 3,800 feet. About 400 feet to the north-west it is again exposed for about 500 feet between elevation 3,900 and 4,600 feet, showing widths from 5 to 7 feet of generally barren or very sparsely-mineralized quartz. Snow obscured tracing of the "Main" vein beyond this point. The vein dips generally between 65 to 75 degrees west and exhibits a fairly well-defined hanging-wall. It is a siliceous replacement-zone and the silicification gradually fades towards the foot-wall. A selected sample of the best mineralization observed in the surface exposures consisting of quartz, pyrrhotite, and pyrite assayed: Gold, trace; silver, trace.

Several small quartz veins striking between north-east and north-west, transverse to the "Bullion" fault, are exposed by natural outcrop or open-cutting in the vicinity of the main



Helena Gold Mines, Ltd. Plan of Surface Workings.

workings. The most extensive exploration has been confined to what is locally called the "South-west" vein. Detailed examination, however, indicates that the widely separated exposures of the so-called "South-west" vein, represent, most probably, a series of veins transverse to the "Bullion" fault and striking at acute angles to each other. This is especially evident in the underground workings. These veins show the best mineralization at intersections with each other and especially with the "Bullion" fault.

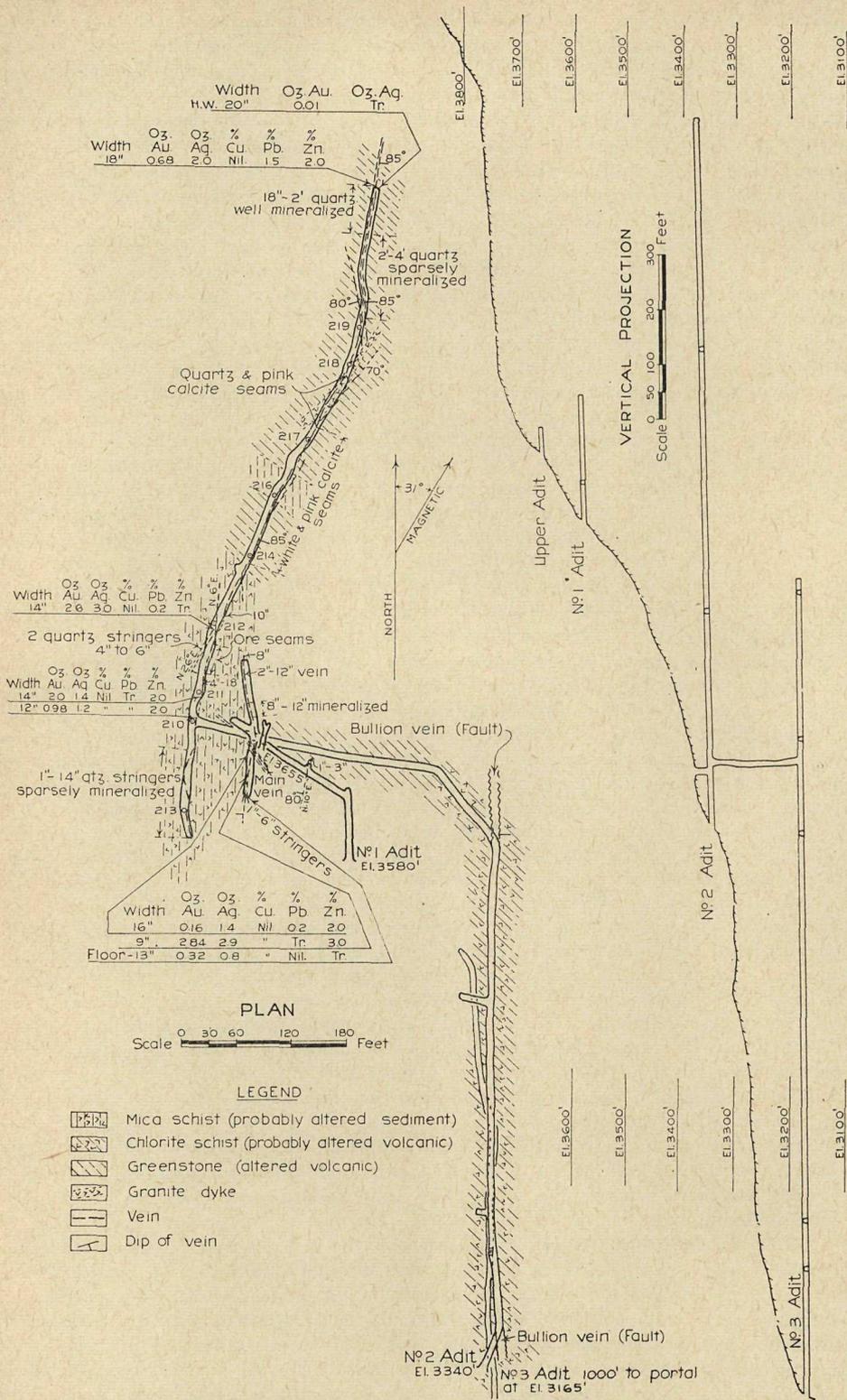
About 240 feet north-westerly from the portal of No. 3 adit, and at about 150 feet higher elevation, a series of open-cuts ("High-grade" cuts) along a distance of 200 feet between elevation 3,315 and 3,370 feet exposes a quartz vein ("South-west" vein) from 6 to 18 inches wide, striking north and dipping from 65 degrees to 80 degrees east. The vein in these cuts is well mineralized with galena, sphalerite, pyrrhotite, pyrite, and arsenopyrite, especially on the hanging-wall side. A selected sample of 6 inches of massive mineralization exposed on the hanging-wall side of the vein in the centre trench assayed: Gold, 13.10 oz. per ton; silver, 30 oz. per ton; lead, 12 per cent.; zinc, 4 per cent. This mineralization and vein have not been located by crosscutting from No. 3 adit-level. It is significant that this mineralization on the surface occurs at about the intersection of the vein with a fault, strike north, dip 60 degrees west, which shows in the crosscut from No. 3 adit-level. Drifting south along this fault and raising to the surface cuts to locate the continuation of the vein would be constructive. About 550 feet north of the "High-grade" cuts, an adit 90 feet long at elevation 3,380 feet exposes a shear 26 inches wide striking north and dipping vertically. The shear is very sparsely mineralized with pyrite and shows some quartz stringers. At elevation 3,675 feet, about 700 feet north of this showing, a quartz vein, 2 feet in width, strike north, dip 62 degrees west, is exposed at its intersection with the "Main" vein. An adit ("Upper" adit) 30 feet long, crosscutting the "Main" vein at this showing, exposes sheared greenstone with silicification across 30 inches mineralized with mainly pyrite and pyrrhotite. A sample across 30 inches of silicification in the face assayed: Gold, trace; silver, 0.2 oz. per ton.

At elevation 3,700 feet, 650 feet north-east of the "Upper" adit and contiguous to a granitic dyke, a quartz vein 30 inches wide, striking north 30 degrees west and dipping 65 degrees west, is exposed in the bed of Bullion Creek, cutting arenaceous argillite. At its intersection with the "Bullion" fault in the creek-bed, this vein is well mineralized in places with sphalerite and pyrite. A sample across 30 inches in the creek-bed assayed: Gold, 0.10 oz. per ton; silver, 1.4 oz. per ton; copper, trace; lead, *nil*; zinc, 2 per cent. This vein is traced north-west by natural exposure across a ridge sloping 30 degrees for a distance of 360 feet to intersection with another north-striking fault in the bed of a small tributary of Bullion Creek at elevation 3,775 feet. Here it is offset 120 feet to the south to elevation 3,750 feet, and can be traced on the west side of the fault for 320 feet to elevation 4,000 feet, where it is obscured by overburden. Several stringers, in places showing massive mineralization of pyrrhotite, sphalerite, pyrite, and some galena, occur in the creek-bed exposure in this locality. A representative sample of a typical stringer, 5 inches wide, assayed: Gold, 4.18 oz. per ton; silver, 0.6 oz. per ton; copper, trace; lead, 0.3 per cent.; zinc, 9 per cent.

The described mineral exposures are mainly in a rock-formation complex of sheared greenstone and tuffaceous sediments. To the north argillaceous sediments predominate. Several small discontinuous and lenticular showings have been located in this formation, amongst which is the so-called "Zinc" vein, located at an elevation of 4,100 feet and about 1,500 feet north of the last-described exposures. A shallow pit sunk on this showing was filled with water.

About 4,000 feet of underground work consisting of drifting and crosscutting, with raises of 150 feet between No. 3 and No. 2 ("Bullion") adits and 25 feet between No. 2 adit and the surface, has been carried out in five adits. The main underground workings are illustrated in the accompanying map.

No. 3 adit, at elevation 3,165, failed to intersect the vein exposed on the surface in the "High-grade" cuts. It then angles towards the "Bullion" fault, which is intersected at station 312 and followed for about 700 feet, showing intensive shearing with some quartz patches and stringers, and occasional sparse, lenticular mineralization with pyrrhotite, pyrite, and sphalerite. The best mineralization occurs 60 feet north of station 314 in a well-mineralized stringer 3 to 8 inches wide for a length of 30 feet. The rock formation on this level is mica-schist probably the result of alteration, partly of argillaceous sediments and partly of



Helena Gold Mines, Ltd. Plan and Vertical Projection of Main Workings.

altered andesitic volcanic rocks. In the raise on the "Bullion" fault-vein between No. 3 and No. 2 adits, a transverse vein 18 inches wide is intersected 48 feet below No. 2 adit.

No. 2 adit, at elevation 3,340 feet, intersects the "Bullion" fault-vein at 45 feet from the portal and continues northerly along it for 570 feet from the portal. The "Bullion" vein as exposed consists of irregular and lenticular masses of quartz from 2 to 4 feet wide, with generally sparse pyrrhotite, pyrite, sphalerite, and some galena, in a well-defined shear dipping vertically or steeply east in chloritic schist. A sample taken across 18 inches at 150 feet north of the winze to No. 3 adit, and representing the best mineralization exposed, assayed: Gold, 0.04 oz. per ton; silver, 0.6 oz. per ton.

Continuing for 570 feet from the portal, the working trends north-westerly through chloritic schist for 105 feet, then turns westerly through greenstone for 210 feet and mica-schist for 60 feet, to intersect a quartz vein. This vein is also exposed in No. 1 adit, 240 feet elevation above No. 2 adit. A sample across this vein, 12 inches wide at the point of intersection, and well mineralized with pyrrhotite, pyrite, some sphalerite and galena, assayed: Gold, 0.98 oz. per ton; silver, 12 oz. per ton; copper, *nil*; lead, trace; zinc, 2 per cent. From the point of intersection a drift south for 80 feet exposes a sparsely-mineralized quartz stringer 1 to 14 inches wide, with some lateral quartz-seams. North from the point of intersection a drift for 630 feet clearly indicates the occurrence of small intersecting transverse veins striking between north-west and north-east, with a tendency for the best mineralization to occur at points of intersection. A close examination shows that this drift follows several such veins which enter and leave the drift at acute angles along the east and west walls in a general rock formation of greenstone. This condition is illustrated in the accompanying map. In the first 500 feet of this drift two short sections of vein, well mineralized with pyrrhotite, pyrite, sphalerite, and some galena, are exposed. The first extends from station 210 for 30 feet north with a vein-width of 8 to 14 inches. A sample across 14 inches at the northern extremity of this section assayed: Gold, 2 oz. per ton; silver, 1.4 oz. per ton; copper, *nil*; lead, trace; zinc, 2 per cent. The second mineralized section with vein-widths from 3 to 30 inches commences 48 feet north of station 211 and extends for 28 feet to just north of station 212. A sample in this section, across 14 inches, 10 feet south of station 212, assayed: Gold, 2.60 oz. per ton; silver, 3 oz. per ton; copper, *nil*; lead, 0.2 per cent.; zinc, trace. It is of importance to note that between stations 210 and 212 the "Main" vein, striking north-west, should be intersected. It is, however, not evident in the drift or the main working to it. Continuing north-easterly for 360 feet beyond station 212, generally barren quartz and calcite stringers and seams are exposed.

At station 219 a well-defined quartz vein, 2 to 4 feet wide, striking north 11 degrees east and dipping 85 degrees easterly, is intersected and continues strongly for 150 feet to the face. For 52 feet from the face this vein is very well mineralized with massive pyrrhotite and pyrite, some sphalerite and galena, across widths of from 18 inches to 2 feet. A sample across 18 inches in the face assayed: Gold, 0.68 oz. per ton; silver, 2 oz. per ton; copper, *nil*; lead, 1.5 per cent.; zinc, 2 per cent. The character of this vein is similar to the described showings in the "Bullion" fault in the bed of Bullion Creek at elevation 3,750 feet, with which structure further work may possibly correlate it.

At elevation 3,580 feet, No. 1 adit intersects the "Main" vein 10 feet from the portal. This exposure is a characteristic siliceous zone, sparsely mineralized with pyrrhotite and pyrite. The adit continues northerly for 65 feet from the portal, and then turns north-westerly for 156 feet. At 122 feet along the north-westerly stretch a transverse quartz vein striking north and dipping steeply west is intersected. It has been drifted on to the south for 60 feet and varies from 4 to 26 inches in width, and is generally well mineralized with pyrrhotite, pyrite, sphalerite, and some galena for a length of 55 feet. Towards the face the vein disperses into several sparsely-mineralized stringers 1 to 6 inches wide which tends to come together towards the floor. The best width is at the intersection of the "Main" vein by the drift about 15 feet from the point of intersection. The following are assay results of samples taken in the south drift.

- (1.) Across 16 inches, south of "Main" vein intersection, 12 feet from crosscut: Gold, 0.16 oz. per ton; silver, 1.4 oz. per ton; copper, *nil*; lead, 0.2 per cent.; zinc, 2 per cent.
- (2.) Across 9 inches, 36 feet south of crosscut: Gold, 2.84 oz. per ton; silver, 2.9 oz. per ton; copper, *nil*; lead, trace; zinc, 3 per cent.

(3.) Across 13 inches in floor at face: Gold, 0.32 oz. per ton; silver, 0.8 oz. per ton; copper, *nil*; lead, *nil*; zinc, trace.

The vein has been drifted on to the north for a distance of 87 feet from the point of intersection. The vein as exposed in this drift is erratic and varies from 2 to 12 inches in width, with generally very sparse mineralization.

The No. 1 adit vein and mineralization cannot be definitely correlated with that exposed in the No. 2 adit north drift. It is possible, however, that such continuity may be established by means of raising and sub-levelling in this locality.

It is indicated by surface and underground exposures that the best possibilities for intensified mineralization occur at transverse vein-intersections with each other or with faults. Such places are indicated: (1) South of the present workings on No. 3 level, between that horizon and surface at the "High-grade" cuts; (2) in the locality of the present face of No. 2 level, between that horizon and surface; (3) northerly along the "Bullion" vein on the No. 2 level horizon.

Equipment on the property consists of residence, office, cook-house, sleeping accommodation, and stable at the Beach Camp. At the Cache there is a well-constructed cabin with cooking and sleeping equipment for four men, also a stable. The working camp is equipped with dining-room and bunk-house accommodation for about thirty men, office warehouse, and assay office. The plant consists of two units, made up of two 36-42 Petter semi-Diesel engines; two Gardner-Denver 212-cubic-foot compressors; air-pump and steel-sharpeners, together with electric-lighting equipment.

SALMON RIVER AREA, PORTLAND CANAL.

Bush Cobalt Mines, Ltd. (N.P.L.).

This company was incorporated on January 26th, 1929, under the laws of British Columbia. The authorized capital is \$1,000,000, divided into 2,000,000 shares of the par value of 50 cents each. Of these, 500,000 non-assessable shares were issued to the Cobalt Syndicate, vendors of the *Cobalt* group, and 500,000 non-assessable shares to the Bush Consolidated Gold Mines, Incorporated, vendors of the *Exchange* group. O. B. Bush, Vancouver, is president of the company, and the registered office is at 375 Dunsmuir Street, Vancouver.

In November, 1935, the Cardinal Mining and Development Company, Limited, optioned a 55-per-cent. interest in the property of this company in consideration for the expenditure of \$75,000 within three years, the work to commence early in 1936. In this respect no work was done on the property during 1936. (*See Bush Consolidated Gold Mines, Limited.*)

The property comprises eight Crown-granted mineral claims and fractions and one surveyed but not Crown-granted fraction. These consist of *Exchange Nos. 1, 2, 3, 4, 5*, being respectively Lots Nos. 1843, 1844, 1845, 1846, 1847, constituting the *Exchange* group, and the *Winner, Cobalt, and Cobalt No. 2*, being respectively Lots Nos. 4116, 4053, 4054, known as the *Cobalt* group. The property is located between 1,500 and 3,000 feet elevation on the east side of Cascade Creek, in the Upper Salmon River Valley, Portland Canal Mining Division, about 15 miles from seaboard at the village of Stewart. The claims adjoin the *Extenuate* group on the south and west, the *Sebakwe* group on the north and west, and the *Mineral Basin* and "45" groups on the east.

The property is reached by motor-road from Stewart and a branch trail about a quarter of a mile in length leads from this road at elevation 1,725 feet along a gentle hill-slope to the cabin at elevation 1,590 feet.

The cabin, 33 by 21 feet, is a two-story structure and in good condition. The main adit (lower) is situated at elevation 1,540 feet, about 450 feet north 8 degrees west of the cabin, on the 30-degree, partially-benched hill-slope to Cascade Creek and about 200 feet in elevation above the creek. A blacksmith-shop in bad condition is located at the portal of the main adit.

The exposed rock formation in and around the workings is a greenstone and tuff complex of the Bear River series, generally intensively jointed. Major jointing strikes north 30 degrees east and dips 60 degrees west, and minor jointing strikes north 60 degrees east and dips 50 degrees north-west. In places shearing along major joint-planes has occurred and the rocks are generally slightly pyritized. A feldspar-porphry dyke striking north-west cuts across a steep draw between the upper (elevation 1,625 feet) and lower (elevation 1,540 feet) adits.

Very little surface exploration has been done on the property. This consists mainly of some stripping and open-cutting (now caved) along what appears to be a fault in a steep

draw adjacent to the adits. An elevation 1,800 feet, about 300 feet north-east of the main adits, an open-cut exposes irregular patches and stringers of white quartz up to 18 inches in width in slightly silicified greenstone, sparsely mineralized with pyrite. At elevation 1,650 feet, south 75 degrees east from the cabin and 30 feet from the trail, an open-cut and short adit in tuff exposes a quartz vein 2 to 9 inches wide well mineralized with pyrite, sphalerite, and galena. This vein strikes north 23 degrees west and dips 85 degrees south-westerly. To the north it is traced for 30 feet across a small knoll which rises to a height of about 20 feet from the surrounding muskeg flats. Southerly continuity is obscured by muskeg overburden. An open-cut, 30 feet long ending in an adit 20 feet long, has been excavated into the knoll with a back of 12 feet, exposing the vein 2 to 9 inches wide and well mineralized. A representative sample of the vein exposed in this work assayed: Gold, 0.36 oz. per ton; silver, 8 oz. per ton; copper, trace; lead, 5.5 per cent.; zinc, 1.3 per cent.

At elevation 1,625 feet on the south side of a steep draw, an adit bearing south 65 degrees east for 16 feet intersects a defined shear striking south 21 degrees east and dipping 70 degrees south. The adit turns to a bearing south 13 degrees east for 36 feet at an acute angle across the shear. In this length the shear is quite pronounced, heavily oxidized, and contains gouge for a width of 2 feet.

Just beyond the point of intersection a quartz vein 2.2 feet wide, mineralized with irregular patches and blebs of pyrite, sphalerite, and galena, occurs on the foot-wall side of the shear. This dips 60 degrees south-westerly and strikes south 43 degrees east into the north side of the drift and probably represents the foot-wall segment of a vein faulted by the shear. A sample across 2.2 feet of this vein in the north side of the drift assayed: Gold, 0.10 oz. per ton; silver, 1.6 oz. per ton; lead, 0.4 per cent.; zinc, 0.8 per cent. The vein is shattered and disturbed at this point of intersection with the shear. To the south-east, along its strike, additional "back" would be gained and a more stable condition of vein-structure and mineralization may occur.

At elevation 1,540 feet, about 100 feet west of the upper adit and on the south side of the same draw, an adit has been driven for 72 feet bearing north 77 degrees east, then north 52 degrees east for 27 feet through sheared, jointed, and slightly pyritized tuff. The face has been "side-swiped" for a width of 16 feet along a gouge-seam 1 inch wide, striking north 38 degrees west and dipping 85 degrees south-westerly. It is possible that the upper-adit shear may be intersected by an extension of the lower adit. In this event, drifting along it may locate the vein showing on the foot-wall side of this shear in the upper adit.

This company, incorporated at Ottawa, Ontario, with a capitalization of \$4,000,000, was registered in British Columbia as an extra-provincial company in February, 1923. In 1929 the holdings of the company consisted of eight claims—*Vancouver No. 2, Vancouver No. 3, Diamond Fraction, Ruby Silver, Ruby Silver No. 1, Ruby Silver No. 2, X. Fraction, and X.X. Fraction*, embracing about 180 acres. On February 15th, 1937, the company was removed from the register and its registration in British Columbia cancelled.

The property is located in the Upper Salmon River area, Portland Canal Mining Division, about 16 miles by road and trail from seaboard at the village of Stewart. It is situated along the west bank of Cascade Creek between 1,000 and 2,000 feet elevation. The claims adjoin the *Woodbine* group on the south, the *Mineral Basin* group on the north-east, and the *Northern Light* group on the east. The property is reached by the Stewart-Premier Motor-road for 13 miles to elevation 800 feet. At this point a wagon-road, with a bridge (in bad condition) across Cascade Creek, extends for about 1½ miles along a fair grade to the *Woodbine* camp at elevation 1,000 feet. From this place a good trail (original Big Missouri Trail) extends with good average grade for about 1 mile along the generally precipitous and rock-bluffed west side of Cascade Creek to the cabin at elevation 1,200 feet. The area immediately surrounding the cabin and workings is a comparatively flat and swampy bench about 250 feet wide intersected by rocky knolled and bluffed ridges and sloping at about 30 degrees to Cascade Creek at about 250 feet lower elevation. The topography, while rugged, is generally not so rough as the average for the area. The locality is densely timbered with hemlock, cedar, and some spruce, and excellent water is readily available from several easterly-flowing creeks tributary to Cascade Creek. Cascade Creek also offers a handy source of water-power.

The rocks underlying the property are tuffs and greenstone of the Bear River formation, and intrusive porphyritic granodiorite. These rocks are all intensively altered and are intruded

by granitic dykes which strike north-westerly and are later than the mineralization. Although numerous such dykes occur in the vicinity, none were seen in the workings. A belt of altered porphyritic granodiorite strikes northerly across the property, adjacent to the workings, and forms the precipitous bluffs paralleling the trail. The workings are on the east border of this belt, partly in the granodiorite and partly in the adjacent tuffs. Both the granodiorite and the tuffs are moderately silicified in places, and in sections of greatest alteration are mineralized with disseminated pyrite and, rarely, with small blebs of sphalerite and galena. Some fracturing and shearing occurs, striking generally slightly east of north and dipping flatly west.

Exploration of silicified areas in both the granodiorite and tuff has been done between 1,125 and 1,235 feet elevation by extensive stripping, several open-cuts, and two adits, 37 feet and 6 feet long.

At elevation 1,235 feet, about 200 feet south 65 degrees west of the cabin, an open-cut in altered porphyritic granodiorite adjacent to the trail exposes a few small quartz stringers and weak silicification very sparsely mineralized with blebs of pyrite.

At elevation 1,210 feet, about 150 feet south 58 degrees west of the cabin, an adit has been driven north 76 degrees west for 37 feet in altered porphyritic granodiorite. At the portal a defined silicified zone 9 feet wide, strike north 8 degrees west, dip 30 degrees west, is cut. The silicification extends for 2 feet in the hanging-wall side and is sparsely mineralized with blebs of pyrite and a few stringers and patches of sphalerite. A sample across 9 feet of the best mineralized section of this exposure assayed: Gold, 0.06 oz. per ton; silver, 0.6 oz. per ton; lead, *nil*; zinc, 0.4 per cent. An average sample of the zone across 9 feet assayed: Gold, 0.02 oz. per ton; silver, 0.3 oz. per ton; lead, trace; zinc, 0.6 per cent. This zone has not been traced on the surface. At 20 feet from the portal the adit cuts a barren quartz stringer, 2 to 6 inches wide, striking north 47 degrees east and dipping 45 degrees south-east. An open-cut directly above the adit, at 15 feet higher elevation and 30 feet north 76 degrees west from the portal, exposes some weak silicification and several quartz stringers, one of which is 3 inches wide and fairly well mineralized with disseminated pyrite, sphalerite, and galena. This stringer should appear in the adit, but is not exposed.

At elevation 1,175 feet, and 75 feet south 33 degrees east from this adit, an open-cut 20 feet long ending in an adit 6 feet long has been excavated in a bluff-face of altered porphyritic granodiorite showing a little disseminated pyrite. In the open-cut leading to the adit, silicified granodiorite 12 inches in width showing sparse sphalerite and galena mineralization is seen. This adit was probably started for the purpose of intersecting the silicified zone exposed at the portal of the upper adit, but would have to be driven between 30 and 40 feet to do so. Two open-cuts, respectively 60 and 75 feet north and south of this adit, expose altered granodiorite, weakly silicified, and in the southerly cut is very sparse pyrite and sphalerite.

At elevation, 1,165 feet, and 90 feet south 88 degrees east of this adit, extensive shallow stripping extends down the bench-slope for 150 feet to the brink of a bluff 15 feet high at elevation 1,140 feet and about 50 feet from the east boundary of the property. This work exposes altered bedded pyritized tuff, strike north 73 degrees west, dip 30 degrees northerly, containing a few quartz stringers and silicified patches. A composite sample of the silicified and pyritized sections exposed in this stripping assayed: Gold, trace; silver, trace; lead, *nil*; zinc, *nil*.

In an open-cut at the bottom of the bluff at elevation 1,125 feet there is a small patch of silicification in pyritized tuff. About 80 feet north-easterly of this there is an open-cut in oxidized tuff.

At elevation, 1,250 feet, 350 feet north-west of the cabin and commencing 50 feet north-east of the trail, there is a continuous length of 200 feet of shallow stripping. This cuts across the gentle bench-slope in an easterly direction to the edge of a bluff about 30 feet high. It commences at the easterly edge of the porphyry and exposes the adjacent tuffs, showing finely-disseminated pyrite, but no shearing structure, quartz veins, or silicification.

Most of the described work was done in 1929, since when the property has been idle. Other references to the property appear in Annual Reports of the Minister of Mines for the years 1923, 1925 to 1927, and 1929.

Boundary. This group consists of the *Boundary Nos. 1, 2, 4, and Missing Link Fraction*, Crown-granted claims, and the *Boundary No. 3* unsurveyed mineral claim, owned by D. L. McIntominey, of Anyox. The property is situated in the Upper Salmon River area at an elevation of about 2,100 feet, or 1,000 feet above the Salmon Glacier on the steep west slope of the Big Missouri Ridge. It is reached by motor-road from seaboard at the village of Stewart for a distance of 13 miles to 800 feet elevation, thence by wagon-road for 1½ miles to the *Woodbine* camp at 1,000 feet elevation. From here the old *Big Missouri* trail is followed for about 1½ miles along the rugged and bluffed west bank of Cascade Creek to 1,400 feet elevation. From this point the *Indian* trail, which switchbacks up the 20- to 40-degree rock-bluffed south slope of Big Missouri Ridge, is followed for about 1 mile to 1,900 feet elevation. At this place an old trail in bad condition and densely overgrown with underbrush is followed for about 1½ miles along the thickly-timbered and frequently rock-bluffed west side of the ridge, sloping 30 to 40 degrees to the Salmon Glacier about 700 feet below. The last stretch of this trail to the workings is practically obliterated. The claims, which are situated about 1 mile south-easterly of the *Big Missouri* holdings, can perhaps be more conveniently reached from the *Big Missouri* camp at 2,500 feet elevation by following an old trail about timber-line to No Name Lake, then a line of least resistance around the east side of the lake and down the ridge-slope to the workings.

The property is adjoined on the north-east by the *Iron Cap* claim and *Silver Coin* group, and on the east by the *Pay Roll* and *Indian* groups. On the south and south-west it is adjoined by the old *Glacier* and *Alaska-Canadian* groups. The area of the claims and workings embraces the bluffed and densely-timbered 30- to 40-degree west slope of Big Missouri Ridge to the Salmon Glacier, and the west boundary of the claims practically abuts on the east rim of the glacier. The northerly section of the property is cut by the deep and rugged rock canyon of Myrtle Creek, which is the southerly drainage-outlet of No Name Lake.

The rock formations of the locality consist of andesitic tuffs and altered volcanics (greenstone) of the Upper Bear River formation (Hazelton group), overlain in a few places by small argillite remnants of the Nass formation. These rocks are intruded by granitic dykes striking generally north-east.

The mineral deposit consists of a well-defined silicified zone, up to and over 23 feet in width, striking from north 13 to 8 degrees west and dipping generally vertically to 80 degrees east and west. The zone is generally well silicified and is well mineralized with blebs, streaks, and disseminated fine-grained pyrite, chalcopyrite, sphalerite, and galena. In places unsilicified patches and fragments of argillite and chlorite are contained in the zone. The zone is traced north-westerly along the steep hill-slope for 625 feet at about 2,150 feet elevation on the south side of Myrtle Creek Canyon by four open-cuts and a short adit. On the north side of Myrtle Creek and about 1,000 feet north-westerly of the last south-side cuts are two open-cuts in argillite reported to expose about 3 feet of brecciated silicification.

At 2,150 feet elevation, No. 1 open-cut exposes well-mineralized silicification for a width of 5 feet in greenstone. On the east side of this cut there is a well-defined foot-wall striking north 3 degrees west and dipping 30 degrees west, but the hanging-wall is not exposed. A felsite dyke 2 feet wide intersects the vein on the east side of this cut. A representative sample of the mineralization in this cut assayed: Gold, 0.06 oz. per ton; silver, 5.2 oz. per ton; copper, 0.5 per cent.; lead, 0.4 per cent.; zinc, 3 per cent.

At 2,160 feet elevation, 75 feet north 26 degrees west of No. 1 cut, a well-silicified zone 10 feet wide is exposed in No. 2 cut. Silicification extends for about 3 feet into the foot-wall. A felsite dyke lies adjacent to the vein on the hanging-wall side in a volcanic breccia. The formation on the foot-wall side is greenstone, intersected to the east by a diorite dyke. In this cut the zone strikes north 13 degrees west and dips 80 degrees easterly. The zone is well mineralized in this exposure with pyrite, sphalerite, galena, and chalcopyrite. A representative sample of the zone in cut No. 2, across 10 feet, assayed: Gold, 0.05 oz. per ton; silver, 3 oz. per ton; copper, 1 per cent.; lead, 3 per cent.; zinc, 7.5 per cent.

At 2,150 feet elevation, about 50 feet north 15 degrees west of No. 2 cut, an adit, in the face of a vertical bluff 15 feet high, has been driven north 87 degrees east for 33 feet. The first 10 feet of this adit is in greenstone, after which the hanging-wall of the silicified zone is intersected, striking north 6 degrees west and dipping vertically to 85 degrees west. The adit continues in the zone for 23 feet to the face, showing intense silicification and generally sparse

mineralization with irregular blebs of pyrite, sphalerite, galena, and some chalcopyrite. At 10 feet from the face a well-defined fracture striking north 8 degrees west and dipping 30 degrees west cuts through the zone. Branching from this fracture in the north wall of the adit another well-defined fracture cuts into the south wall, striking north 25 degrees west and dipping 80 degrees south-westerly. Branching from this in the roof and cutting into the north wall a well-defined fracture strikes north 22 degrees east and dips 80 degrees easterly. The best mineralization in the adit extends from these fractures to the face. A sample of the face and 4 feet of both walls assayed: Gold, 0.04 oz. per ton; silver, 2.6 oz. per ton; copper, 0.6 per cent.; lead, 3.5 per cent.; zinc, 9 per cent.

At 2,100 feet elevation 150 feet north 22 degrees west of the adit, No. 3 open-cut in the face of a bluff 12 feet high exposes a well-defined quartz cross-vein 17 inches wide. This is well mineralized with sphalerite, galena, chalcopyrite, and bornite, and occurs in volcanics (greenstone) adjacent to a diorite dyke on its foot-wall side. This vein strikes north 38 degrees west and dips 85 degrees south-westerly. Continuity in both directions beyond the cut is obscured by heavy timber and overburden. A sample across 17 inches representative of this vein in No. 3 cut assayed: Gold, 0.04 oz. per ton; silver, 8 oz. per ton; copper, 3 per cent.; lead, 4 per cent.; zinc, 12 per cent.

At 2,160 feet elevation, 350 feet north of No. 3 cut, No. 4 open-cut in the steep south bank of Myrtle Creek exposes weak silicification and some shearing in an oxidized rock.

At 2,500 feet elevation, on the north side of Myrtle Creek Canyon and about 1,000 feet north-westerly of No. 4 cut, are two open-cuts reported to expose a quartzose brecciated zone in argillite, 3 feet wide, mineralized with patches of pyrite and galena. These cuts are in a densely-timbered and underbrushed terrain and could not be located.

The attitude of the zone on the south side of Myrtle Creek, in relation to the steep slope of the ridge, lends itself to convenient depth-exploration by diamond-drilling.

Additional references to this property can be found in the Annual Reports for the years 1911 and 1917 to 1919.

This corporation was incorporated on August 1st, 1923, with a capitalization of \$3,000,000, divided into 3,000,000 shares. It was a reorganization of **Indian Mines Corporation, Ltd.** Indian Mines, Limited, which was incorporated in 1911 with 1,000,000 shares of the par value of \$1 each, increased in 1922 to 1,600,000 shares of the par value of \$1 each. J. Fred Ritchie, Prince Rupert, is president; L. W. Patmore, Prince Rupert, is secretary; and the registered office is at Prince Rupert. The holdings consist of *Portland No. 1* and *No. 2*, *Big Dick*, *Fritz*, *Morn*, *A.M. Fraction*, *O'Brien Fraction*, and *Maggie Jiggs Fraction* Crown-granted mineral claims. Although varying and generally low-grade gold values, with mainly zinc and lead sulphide mineralization, occur in the mineral deposit on this property, it is included under the heading of "Gold Deposits" because it is located in an area that is viewed as a gold-bearing area and in a rock formation known to be favourable in the area for the occurrence of gold-bearing deposits.

The property is located in the Upper Salmon River area of the Portland Canal Mining Division on the west side of Cascade Creek and on the south slope of Big Missouri Ridge between 1,500 and 2,600 feet elevation. It is reached by the Premier Motor-road from seaboard at the village of Stewart for 13 miles to 800 feet elevation. From here a wagon-road along a fair grade extends for about 1½ miles to the *Woodbine* camp at 1,000 feet elevation. The old Big Missouri Trail is then followed for about 1½ miles along the steep and rock-bluffed west bank of Cascade Creek to 1,400 feet elevation where a good pack-horse trail branches off and switchbacks for about 1¼ miles up the comparatively rocky south slope of Big Missouri Ridge to the *Indian* camp at 2,100 feet elevation. The topography of the area is comparatively rugged, though not as rough as that of the main mountain-range sections of the Portland Canal area. Big Missouri Ridge, trending north, separates the Salmon River Valley and Glacier on the west from Cascade Creek Valley, on the east. Steep, heavily-timbered, and locally-precipitous and rock-bluffed sides slope to these valleys from a ravined, knolled, and lightly-timbered crest of 2,900 feet in the locality of the *Indian* property. Timber-line is at about 3,000 feet elevation. The camp is situated on a flat, grassy bench, well suited to this purpose, but all the camp buildings have either collapsed or been destroyed by fire. Two strongly-constructed corrugated-iron shelters at the portal of No. 3 adit probably contain a power plant.

The area is in the eastern contact belt of the Coast Range batholith and about 1½ miles east of the main contact of the batholith. The rock formations of the locality are andesitic volcanic tuffs and breccias, some argillaceous sediments of the Upper Bear River formation (Hazelton group), and irregularly intruded porphyritic granodiorite. These rocks are generally altered extensively by both replacement and shearing, the flows and tuffs being largely changed to greenstone and the local areas of argillite to chert and quartzitic slate. These rocks are intruded by granitic and dioritic dykes and later lamprophyre dykes. On the property, porphyritic granodiorite has the greatest distribution and forms the general host-rock of the mineral deposit. It varies from coarse and porphyritic in texture to very fine-grained and dense. Phenocrysts of orthoclase and plagioclase up to ½ inch long are sometimes seen in a dense greenish or greyish ground-mass and occasionally grains of quartz. Where not evident to the naked eye, halos or "ghosts" of these crystals can sometimes be seen in the dense and frequently highly-altered ground-mass by use of the magnifying-glass. In places this rock is calcareous and sericitic, and in such sections of greatest alteration is difficult to distinguish from the tuffs and flows (greenstone). As is general in the area, gradational or digestion contacts between the intrusive and the volcanic rocks are characteristic. Adjacent to the best mineralized sections of the deposit, the granodiorite is generally silicified, calcareous, and frequently sericitized.

The mineral deposit consists of lenticular and irregular siliceous replacements in a shear-zone. The zone is irregularly mineralized, along comparatively short lengths, with bunches, pockets, and lenses of chiefly sphalerite, galena, and pyrite. Silicification varies from about 2 feet wide to lenticular widths of 25 feet, and locally more or less massive mineralization extends across the entire width. The shear-zone strikes north and dips vertically to steeply east or west. Where explored in the underground workings it is characteristically irregular and frequently splits into branch mineralized fractures which disperse or are cut off by transverse fractures. Many unmineralized fracture-planes traverse the formation. One series strikes north 20 degrees west and dips 70 degrees westerly; another series strikes north parallel to the main zone and dips 80 degrees east; a third strikes north 10 degrees east and dips 75 degrees east; and a fourth series strikes north 30 degrees east and dips 85 degrees easterly. Although major faulting could not be definitely established, small dislocations undoubtedly occur, and it may be found that major faulting has occurred and to some extent may have caused the apparent irregular nature of the zone as exposed underground.

The zone outcrops at 2,200 feet elevation above the portal of No. 2 adit; at No. 1 adit-portal at 2,244 feet elevation; and has been traced by a series of outcrops and open-cuts for about 1,200 feet north to 2,525 feet elevation. The open-cuts are generally caved and overgrown with brush. Extensive oxidation, silicification, and some sulphide mineralization can still be observed in some of them. In No. 3 open-cut ("Galena cut"), at 2,343 feet elevation and 200 feet north-westerly of No. 1 adit-portal, a zone-width of 14 feet is exposed. This is appreciably oxidized, but well-developed sulphide mineralization is seen, of which a width of 7.5 feet is mainly massive galena, with some pyrite and sphalerite. Siliceous outcrops with irregular mineralization and oxidized quartz are seen at seven places along a distance of 1,000 feet north of No. 3 cut to 2,525 feet elevation.

The deposit has been explored underground by three adits, at elevations 2,033, 2,191, and 2,243 feet, and about 6,790 feet of diamond-drilling in thirty-four holes from No. 1 and No. 3 adits. The bulk of the work was done between 1923 and December, 1925, when operations ceased and a watchman was placed in charge until the camp was destroyed by fire about 1931.

No. 1 adit, at 2,243 feet elevation, is a drift along a general northerly bearing for 1,240 feet, with about 1,040 feet of subsidiary crosscutting and drifting and about 130 feet of raising in two raises. In this adit six sections, moderately to well mineralized with quartz and sulphides, with a total length of 590 feet and varying in width from 3 to 25 feet, have been found. Sphalerite is the predominant mineral in these sections, with accompanying galena and pyrite. The first mineralized section occurs for a length of 160 feet from the portal of No. 1 adit, at which point the zone is intersected by a dioritic dyke 45 feet wide, striking north 70 degrees west across the adit. Some "side-swiping" and crosscutting has been done along this section, exposing moderate silicification and sparse mineralization across widths varying from 3 to 20 feet. The greatest width is close to the intersection of the vein by the dyke. At this point 104 crosscut extends westerly for 42 feet, and 20 feet from its face is a raise for

about 90 feet to the surface under the "Galena cut." This was not accessible and was not examined.

The second mineralized section in No. 1 adit commences at the north contact of the dyke and continues for 85 feet along the main drift and 106 crosscut to the top of a raise from No. 2 adit. This section is generally very well mineralized with sphalerite, galena, and pyrite across widths from 2 to 8.5 feet. The widest point, at 105 crosscut and 30 feet south of the raise, is a junction of two siliceous zones, the west and best-mineralized continuing along 106 crosscut and fading out towards the raise. The east zone, showing good silicification but practically no mineralization, continues along 107 crosscut for 80 feet, where there is another length of 42 feet, well mineralized across widths of $1\frac{1}{2}$ to 5 feet. From this point there is a stretch of 170 feet showing only a few narrow quartz stringers. Following this is a section of drift-width silicification for a length of 100 feet, showing good sulphide mineralization across widths of 2 to 13.5 feet. A crosscut (111) for 65 feet to north-east at the section of greatest width continues in barren granodiorite and enters a basic dyke at the face. In the drift 20 feet north of 111 crosscut the mineralization and silicification fades out along a branch fracture striking north-east. Crosscut No. 112 follows this for 25 feet, where it is cut off by a transverse fracture which strikes north and dips 47 degrees west. This crosscut continues for 65 feet to the basic dyke intersected in 111 crosscut. In this area an exploratory west drift for 190 feet intersects several fractures striking north and north-east, but no mineralization is exposed.

At 60 feet north of 112 crosscut the main drift enters a well-silicified structure, striking north-westerly and dipping 85 degrees north-east, well mineralized locally across widths of 2 to 6.5 feet for a length of 170 feet. At the north end of this length, and the point of strongest silicification, the drift swings east, away from the zone, with sparsely-silicified granodiorite in which it continues for 40 feet. It then swings sharply west into the zone again and continues in crosscut 114, which intersects a width of 25 feet of the best mineralization exposed in No. 1 adit. A sample of the south side of 114 crosscut across a width of 25 feet assayed: Gold, 0.14 oz. per ton; silver, 6 oz. per ton; copper, 0.2 per cent.; lead, 5.5 per cent.; zinc, 10.6 per cent. The vertical distance to the surface at this point is about 245 feet, but no raising has been done to prove the continuity of the mineralization in this section. It may prove to be lenticular. Irregular silicification, with bunched but fair mineralization across widths of 4 to 7 feet, continues in the drift for about 30 feet north of 114 crosscut and then gradually fades into quartz and calcite stringers with sparse pyrite mineralization.

Fifty feet north of crosscut 114, crosscut 115 for 50 feet south-west intersects sparse silicification with sparse pyrite mineralization. At 70 feet north of crosscut 115, crosscut 116 for 170 feet north-west intersects a few quartz and calcite stringers, some weak silicification, and sparse pyrite mineralization.

No. 1 adit continues in granodiorite for 170 feet north of crosscut 116 to the face, intersecting a pronounced fault-plane striking north-westerly and dipping 40 degrees north-easterly, and a few quartz and calcite stringers with sparse pyrite mineralization. About 5,316 feet of diamond-drilling in twenty-four holes was done from No. 1 adit.

No. 2 adit, at 2,191 feet elevation and 160 feet south-easterly of No. 1 adit, was started under the lowest and best surface showings. It is driven in a northerly direction for 490 feet, and branching from the main drift are 670 feet of subsidiary drifts, crosscuts, and "side-swiping," with two raises of 50 and 25 feet and one winze 7.5 feet deep. In these workings a much more scattered, lenticular, and irregular condition of silicification and mineralization is disclosed than in No. 1 adit.

The portal of No. 2 adit is at the contact of a lamprophyre dyke intersecting granodiorite at an acute angle across the adit. This dyke is again intersected by 206 and 209 west crosscuts. At 350 feet north of the portal the adit intersects a diorite dyke 60 feet wide striking easterly. This dyke is also intersected 25 feet to the east by 207 crosscut and drift, and a crosscut extending east from this intersects a lamprophyre dyke striking north-east at its face. The rest of No. 2 adit-workings are in porphyritic granodiorite.

In the main drift of No. 2 adit and 200 feet from its portal scattered silicification with very sparse mineralization is encountered. Forty feet north of this point a length of weak silicification is exposed with fair mineralization across widths of $2\frac{1}{2}$ to 4 feet. Thirty-five feet north of this, 207 crosscut east intersects at 25 feet from the main drift a branch silicified structure striking north-easterly and dipping 35 degrees north-westerly. This is cut off at its

south end by a fault striking north and dipping steeply west. The branch-structure is drifted on to the north for 160 feet, showing well-mineralized silicification across widths of 1 to 5 feet.

The northerly 35 feet of this length is in the diorite dyke and the silicification at the end of this stretch cuts into the west wall of the drift. A crosscut to the west, about 40 feet to the north, has failed to pick up the extension. A raise for 55 feet from 207 crosscut on the foot-wall of the mineralization was inaccessible and was not examined, but is reported in the Annual Report of the Minister of Mines, 1922, page 85, to disclose encouraging widths of good mineralization. In an incline winze, 7.5 feet deep, at the north end of this mineralized stretch there is a 6- to 16-inch width well mineralized with sphalerite, galena, pyrite, and chalcopyrite. A sample across this width, representing the exposure on the east side of the winze, assayed: Gold, 1.22 oz. per ton; silver, 8 oz. per ton; copper, 1 per cent.; lead, 6.6 per cent.; zinc, 17 per cent.

The best mineralization in No. 2 adit is seen at the north end of the main drift. Here there is a length of 60 feet, continuing to the face, well mineralized across widths of 4 to 15 feet. In this section a raise of 50 feet extends to No. 1 level. A sample across 10 feet of mineralized silicification on the south wall of a crosscut to the west, at the face of No. 2 adit, assayed: Gold, 0.08 oz. per ton; silver, 2.2 oz. per ton; copper, 0.1 per cent.; lead, 7.2 per cent.; zinc, 8.9 per cent.

No. 3 adit is at 2,033 feet elevation and 280 feet south-easterly from No. 2 adit. It is driven in a northerly direction for 1,300 feet, with 920 feet of lateral crosscuts and drifts. For 240 feet from the portal the adit is driven in tuffs, but continues in granodiorite to 40 feet from the face, where argillite is entered and continues to the face. In the east and west crosscuts, lamprophyre and diorite dykes and a few bands of tuff are locally intersected. A few isolated, generally barren streaks of silicification and quartz stringers are encountered in these workings, and three very small and unimportant patches of sulphide mineralization. The best silicification seen is weak, irregular, and practically barren, extending for about 100 feet from the portal. Ten diamond-drill holes were drilled east and west from these workings, totalling 1,473 feet, and are reported by the president of the company to have encountered some mineralization and low-grade values to the west.

Whereas gold and silver values in the mineralized sections disclosed in No. 2 and No. 1 adits and on surface are generally low grade, methodical sampling of these disclosures, together with a conducive market price for lead and zinc, may indicate a grade and possible tonnage sufficient to warrant further development on these horizons. The best mineralization and structure on No. 2 adit is disclosed at the north end of this working.

Additional references to this property can also be found in British Columbia Minister of Mines' Annual Reports for 1910, 1912, 1913, 1917 to 1920, and 1922 to 1925; also Geological Survey of Canada Memoirs 32 and 132.

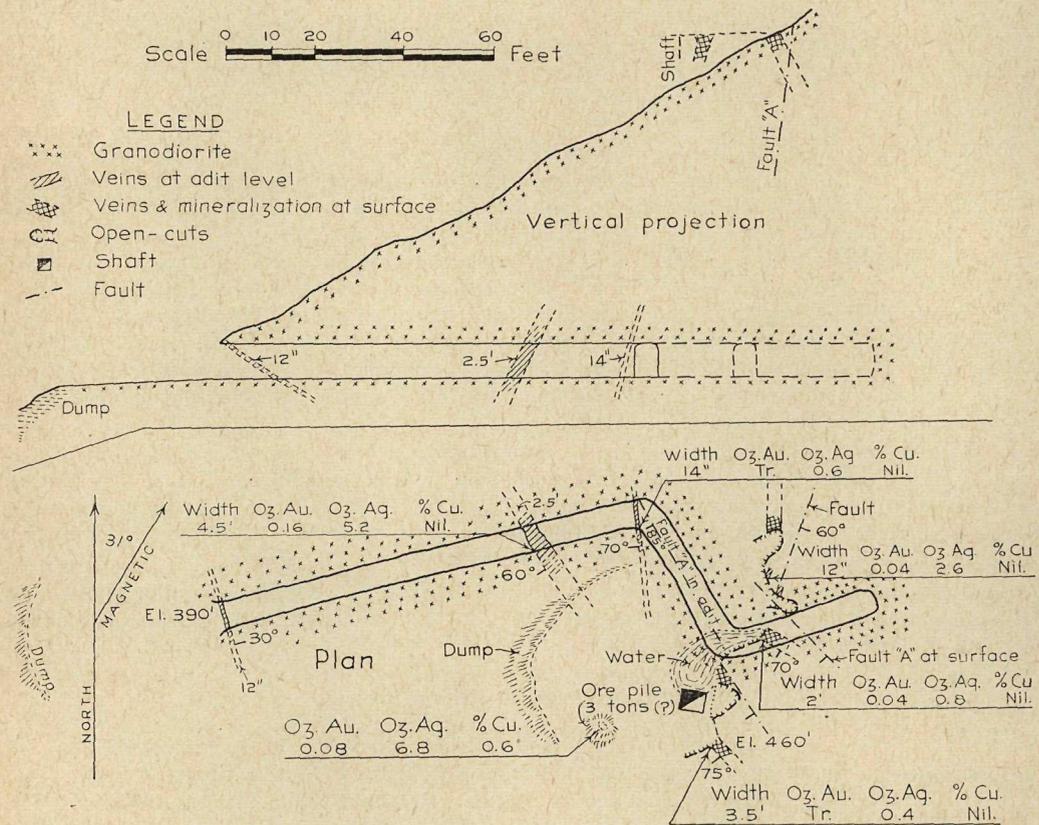
BEAR RIVER AREA, PORTLAND CANAL.

Mayflower. This group of ten claims and fractions owned by H. P. Gibson, of Stewart, is situated on the east side of the Bear River Valley, about 6 miles from seaboard at the village of Stewart, Portland Canal Mining Division. The southerly claims of the group are adjoined on the south by the northerly claims of the Dunwell Mines, Limited, and to the east the group is adjoined by the *Silver Ledge* group and Victoria Mines property. To the west the claims abut on the Bear River Valley bottom. The property is reached by the Bear River Motor-road from Stewart for 6 miles to elevation 200 feet, from where a trail switchbacks for half a mile up the 20-degree rocky slope of the mountain to the cabin at elevation 410 feet. The west slope of the mountain, along which the claims are located between 200 and 1,500 feet elevation, is thickly timbered with hemlock, cedar, and some spruce, and slopes through rock bluffs and ridges at an average angle of about 27 degrees to the Bear River Valley.

The claims were staked about twenty years ago and in 1928 the Mayflower Mining Company, Limited, was formed and carried out some underground exploration. Since that time intermittent exploration has been done by lessees and during 1936 some prospecting was done. The original discoveries were in the vicinity of the cabin, but about three years ago a new discovery was made several hundred feet southerly of these.

The rock formation of the locality is a small stock of granodiorite intrusive into argillite, tuffaceous sediments, and tuffs of the Bear River formation (lower Hazelton group). The exposed granodiorite occupies a strip aligned north-south, parallel with the Bear River Valley for a length of about 6,000 feet and a width of about 1,200 feet between the valley-bottom at 200 feet elevation to around 1,500 feet elevation. The granodiorite is generally phanero-crystalline with accessory biotite and hornblende. Major jointing strikes north 30 to 60 degrees west and dips steeply south, and minor jointing strikes north and dips steeply east.

The mineral deposit consists of quartz veins and lenses occupying joint-planes in granodiorite, locally sheared, and mineralized with pyrite, chalcopyrite, some galena and sphalerite. On the adjoining *Ben Ali* claim of the Dunwell Company a vein in the southerly section of the granodiorite stock, with similar mineralization as those on the *Mayflower*, contains good gold values and has been extensively mined.



Mayflower Group. Plan and Section of Workings.

On the *Tyee* claim of the *Mayflower* group at elevation 410 feet and about 300 feet east of the cabin a series of open-cuts along the edge of a low bluff expose irregular and lenticular quartz veins and silicification mineralized with pyrite and some sphalerite in blebs and patches. In the most northerly cut a well-defined quartz vein well mineralized with pyrite is exposed, striking north 2 degrees east and dipping 65 degrees east. The vein is obscured by overburden to the north and by talus in the cut. In the southerly extension of the cut along the bluff two patches of quartz, 12 inches wide and well mineralized with pyrite, are exposed on the foot-wall side of a fault which strikes north-easterly and dips 60 degrees south-easterly. A sample across the most westerly quartz-pyrite patch assayed: Gold, 0.04 oz. per ton; silver, 2.6 oz. per ton; copper, nil. The vein or veins exposed in these cuts are probably faulted by "A" fault, which is exposed in the cut about 20 feet south of the most northerly cut. The surface

exposures south of Fault "A" cannot be definitely correlated with the quartz vein in the north cut.

About 5 feet south of Fault "A" a quartzose shear 2 feet wide is exposed in a cut along the brow of the bluff. This strikes south 60 degrees east and dips 70 degrees south-westerly and is sparsely mineralized with pyrite. A sample across 2 feet in this exposure assayed: Gold, 0.04 oz. per ton; silver, 0.8 oz. per ton; copper, *nil*.

About 10 feet south-easterly of this a crescent-shaped cut exposes about 8 feet of siliceous replacement in granodiorite moderately mineralized with pyrite at the north side of the cut and apparently contained in a weak structure striking north-west and dipping steeply south-west. About 5 feet south of this cut siliceous replacement 3.5 feet wide, sparsely mineralized with pyrite, is exposed on the brow of the bluff. This structure strikes south 41 degrees east and dips 75 degrees south-west, and a sample across 3.5 feet assayed: Gold, trace; silver, 0.4 oz. per ton; copper, *nil*. A shaft adjacent to the crescent-shaped cut was filled with water. These structures have not been traced on the surface beyond the cuts where possible continuity is obscured by heavily-timbered and somewhat bouldery overburden.

At elevation 390 feet in the bed of a small creek 120 feet west of these cuts, an adit has been driven north 77 degrees east for 99 feet in granodiorite. At the portal a quartz vein 12 inches wide moderately mineralized with pyrite, striking north 15 degrees west and dipping 30 degrees north-easterly, is intersected. At 71 feet a quartz vein 2.5 to 4.5 feet wide well mineralized with pyrite and sparse galena and sphalerite, striking north 33 degrees west and dipping 60 degrees south-westerly, is intersected. A sample across this vein, 4.5 feet wide on the south wall of the adit, assayed: Gold, 0.16 oz. per ton; silver, 5.2 oz. per ton; copper, *nil*. At 99 feet the adit intersects a quartz vein 14 inches wide, striking north 10 degrees west and dipping 70 degrees west. This vein is sparsely and irregularly mineralized with blebs and small patches of pyrite. A sample across 14 inches in the south wall of the adit assayed: Gold, trace; silver, 0.6 oz. per ton; copper, *nil*. This vein should junction with the second vein at about 50 feet south of the adit. At the north wall of the adit the vein is intersected by a fault striking north 28 degrees west and dipping 85 degrees south-westerly. This is quite possibly Fault "A" exposed in the surface cuts. For some unknown reason the vein has been left unexplored in the south wall of the adit and the fault was drifted on for 36 feet, showing a few narrow patches of barren quartz. The working is then turned north 70 degrees east for 36 feet in barren granodiorite.

Several hundred feet southerly of these showings a new discovery was made in a deep creek-draw. This consists of a sheared quartz vein locally well mineralized with pyrite, chalcopyrite, some sphalerite and galena, striking north 66 degrees west and dipping 67 degrees south-westerly. The vein occurs in granodiorite close to the contact with the overlying volcanics of the Bear River series. The vein outcrops in the steep bed of a creek-draw and at elevation 800 feet an open-cut has been excavated on the showing. This exposes a width of 41 inches of sheared quartzose vein material, of which 18 inches on the hanging-wall is well mineralized. A sample across 41 inches at the bottom of the cut assayed: Gold, 0.2 oz. per ton; silver, 1.8 oz. per ton; copper, trace; lead, *nil*; zinc, 2 per cent.

Continuity of the vein above and below this showing is obscured by overburden and slide-rock in the creek-draw, but at about elevation 1,500 feet an exposure of similar mineralization occurring in hybrid contact-rocks may possibly be correlated with the lower exposure. During 1935 some further exploration of this occurrence was carried out in an adit by a lessee. The results of this work are reported to have been discouraging.

In view of the good gold values in quartz veins similarly mineralized and occurring in the same granodiorite stock on the *Ben Ali* claim, adjoining the *Mayflower* on the south, further exploration of the *Mayflower* veins and detailed surface-prospecting of the *Mayflower* ground is warranted.

TAKU RIVER AREA.

The mouth of the Taku River is at the head of Taku Inlet at about latitude 58 degrees 20 minutes north and longitude 134 degrees west. It is 25 miles north-east of Juneau, Alaska, and 320 miles north of Prince Rupert, British Columbia. The river is the main drainage-trough for about 5,000 square miles of the north-western section of British Columbia. The British Columbia-Alaska boundary crosses the river about 20 miles from its mouth, and at the crossing is practically coincident with the north-westerly-striking eastern margin of the Coast

Range batholith. This feature throws the important mineralization area of the eastern contact-belt in Canadian territory east of the Alaskan Panhandle. The settlement of Tulsequah, B.C., is located near the mouth of the Tulsequah River, a westside tributary, about 6 miles above the International Boundary. The nearest settlements are Atlin, about 143 miles north of the river-mouth, and Juneau, Alaska, 25 miles north-east.

The area is reached by direct and frequent steamship connection from Prince Rupert to Juneau and thence by launch and river-boat up the Taku River to Tulsequah. With the establishment of a Canadian Customs office at Tulsequah in 1936, the facility of aeroplane transportation from Juneau, at seaboard, or Atlin, in the interior, is now also available.

The topography of the country embodies generally those features which are common with other parts of the Pacific slope and eastern contact areas of the Coast Range batholith. The area is rough and rugged with steep heavily-timbered and rock-bluffed slopes rising abruptly from the valleys to bare, precipitous peaks from 5,000 to 8,000 feet in altitude. Detached remnants from the receded ice-sheet fill several glacial cirques of the higher altitudes, and in the central section spectacular glacier-tongues lead from the ice-sheet covering the range to the heads of the valleys and form the sources of the creeks and rivers.

The Taku River and its tributaries are glacier-fed streams, cutting their way through the Coast Range to the sea. The large quantities of transported silt has resulted in the formation of numerous bars, sloughs, low-lying islands, and a network of channels. The main stream is featured by a gradual gradient between its mouth and the Tulsequah River, there being a rise of only 70 feet from sea-level in this distance of 26 miles. Above the Tulsequah the gradient steepens.

The Tulsequah River is a main west-side tributary of the Taku, about 26 miles north-easterly of its mouth. It has its source in the spectacular Tulsequah Glacier, 14 miles north-westerly of its junction with the Taku. It is a much more rapid stream than the Taku and its navigation by small boats is difficult and dangerous. The gradient of the main river-bed averages about $\frac{1}{4}$ per cent. for its entire length. The bed of the Tulsequah is spread over a width of half a mile and is featured by innumerable shallow, fast-flowing, and continuously changing channels, separated by shifting sand and gravel bars. The valley of the Tulsequah varies from $\frac{3}{4}$ to $1\frac{1}{2}$ miles wide. At the junction of the stream with the Taku, on the west side, a flat slough and beaver-dam area $2\frac{1}{2}$ miles wide and 5 miles long is a marked feature. A road extending for 6 miles from the north bank of the Taku to the *Whitewater* property has been constructed on this flat. A remarkable periodical flood condition, of practically annual occurrence, originates on the Tulsequah River. This emanates from the bursting-out from under the Tulsequah Glacier of an enormous volume of accumulating summer water which causes the river to rise 10 to 15 feet in about two days, with equally rapid subsidence. This flood generally occurs between September and November.

The area is on the westerly fringe of the Interior Plateaux region or dry belt. Rain and snow precipitation is moderate and decreases steadily to the eastward. About the beginning of November slush-ice begins to form on the Taku River and navigation is impeded by about November 15th. Towards the beginning of May the lowlands are free of snow and river navigation becomes possible again.

The area in British Columbia is embraced by the eastern contact-belt of the Coast Range batholith. The batholith-contact strikes in a north-westerly direction across the Taku River and appears to follow this course about 6 miles westerly of the Tulsequah River. The rocks east of the contact consist mainly of the older igneous groups, probably Triassic or Jurassic, with some limestone and altered sedimentaries. The igneous rocks and some of the sedimentaries are generally altered, to greenstone, phyllite, and schist. The igneous rocks are generally fine-grained, compact, and heavily silicified and carbonatized and are probably altered andesitic volcanics. Associated with these are fine-grained interbedded tuffs, frequently calcareous and extensively altered by carbonatization and light-grey to buff in colour. Argillites and slates occur towards the head of the Tulsequah River and in the upper stretches of the Taku. Folding, defined fracturing, and shearing is evident contiguous to and within 6 to 7 miles westerly of the batholith-contact. In this belt, major fracturing accompanied locally by well-defined shearing has occurred along north-easterly and north-westerly directions.

There is evidence in the area of the Tulsequah River of a limited amount of prospecting and work by "old-timers," but the date of these activities is not known. In 1925 some placer-gold leases were taken up in the Nakina River area by Kansas City interests. A limited

interest in the section evolved several years ago through the discovery and staking by W. Kirkham, of Juneau, of the *Tulsequah Chief* group on the east side of the Tulsequah River. The first official reference to the area and its mineral potentialities is contained in the Annual Report of the Minister of Mines for the year 1923. In 1923 the *Tulsequah Chief* was bonded to the Alaska Juneau Gold Mining Company, which carried out a small amount of work and later relinquished the option. In 1928 a Juneau syndicate again optioned the *Tulsequah Chief* and in 1929 bonded it to the United Eastern Mining Company, of Los Angeles, which carried out extensive exploration with encouraging results, and although the property has been inactive since 1930, this company still retains its interest. This activity resulted in a revival of prospecting and in 1929 Juneau prospectors staked the *Big Bull* or *Manville* group. Almost immediately this was bonded to the Alaska Juneau Gold Mining Company, which carried out extensive development, but relinquished the option in 1930. Several other promising discoveries were made in 1929 by Alaskan prospectors, amongst which was the *Whitewater* group. The depression period caused a cessation of activity in 1933, but with the encouraging further development of the *Whitewater* interest has again been increasing since 1935. Annual Reports of the Minister of Mines for the years 1923, 1928 to 1933, and 1935.)

This company was incorporated in British Columbia on October 17th, 1936, as a private limited company. On November 4th, 1936, it acquired the interest in **Polaris-Taku Mining Co., Ltd.** est previously held by Edward C. Congdon, Duluth, Minnesota, in eleven mineral claims known as the *Whitewater* group. The registered office is the office of the company's solicitors, Messrs. Robertson, Douglas, and Symes, 640 Pender Street West, Vancouver. Edward C. Congdon, Duluth, is the president of the company.

The property is situated in the Taku River area, the general features of which are described under that heading, introductory to this report. The claims are located between elevations of 100 and 1,000 feet on the west bank of the Tulsequah River, about 6 miles from its confluence with the Taku River. The area is reached by launch from Juneau, Alaska, to the mouth of the Taku River, and thence by specially-constructed river-boat up the Taku River for 26 miles to the settlement of Tulsequah. The British Columbia-Alaska boundary is crossed about 20 miles from the mouth of the Taku River. With the opening of a Canadian Customs office at Tulsequah in 1936, the facility of aeroplane transportation from Juneau at seaboard or Atlin in the interior, can now be utilized. A road, constructed by the present operators, extends for 6 miles through extensive sand and gravel flats along the west bank of the Tulsequah River from its confluence with the Taku River to the camp at elevation 100 feet.

The mineral-showings on the *Silver King No. 4* claim of the *Whitewater* group were originally discovered and staked in 1929 by Art Hedman, Ray Walker, Ray Race, and associates, of Juneau. The group and several adjoining claims were optioned by the N. A. Timmins Corporation, which carried out surface-trenching, open-cutting, and 5,297 feet of diamond-drilling in nineteen holes during the seasons of 1931 and 1932 and then relinquished the option. The Alaska Juneau Gold Mining Company optioned the group and adjoining claims towards the end of 1932, did some underground exploration during 1933, and then relinquished the option. The property was further investigated during the season of 1934 by H. Townsend, of Seattle, and D. C. Sharpstone, of Duluth, with the result that it was bonded by Edward C. Congdon and associates. Further underground exploration and development was commenced by these interests in 1935 and has been carried on continuously since that time.

The topography of the locality is rough and rugged and featured by steep, rock-bluffed mountain-slopes rising from the valley-bottom to bare ridges and peaks of 5,000 to 6,000 feet elevation. The lower slopes are in part deeply covered with clay and moraine overburden and densely timbered with hemlock, cedar, and some spruce to about 3,000 feet elevation. The Tulsequah River occupies a trough $\frac{3}{4}$ to $1\frac{1}{2}$ miles wide, with precipitous rock-bluffed sides along its upper reaches, but moderating to banks of sand and gravel benches and flood-flats near its mouth.

The area lies within the eastern contact-belt of the Coast Range batholith and the locality of the *Whitewater* is about 5 miles easterly of the main batholith-contact. The rocks of the locality are greenstone, calcareous tuff, and mica-schist (phyllite), representing flow and tuffaceous volcanics, possibly in part sedimentary, extensively altered by silicification, carbonatization, and shearing. The main components of the series are massive altered greenstone and mica-schist. Locally, bedding striking about north 30 degrees east and dipping steeply south-easterly, suggesting altered sedimentary rocks in these places, is seen. These rocks are

intruded by felsite dykes which locally are associated with mineralized structures. Extensive post-mineral faulting striking north-westerly to north and dipping 30 to 70 degrees easterly cuts the formation. At least two major faults and several minor faults are known to have dislocated the mineralized zones in varying degree. The mineralization consists of quartz-carbonate stringers, either isolated or distributed in zones across widths of over 20 feet, compact quartz-carbonate veins, shatter- and shear-zones varying from about 2 to 16 feet in width, with the greatest widths generally occurring at vein or zone junctions. The zones strike from north-west to north-east and generally dip fairly steeply south-west and south-east. The main structures consist of a network of quartz veins, stringers, and veinlets with intervening partial or complete silicification of the rock formation. Locally, small fault-displacements of a few inches, together with bending and shattering, affects the quartz and carbonate veins, stringers, and veinlets in the zones. A brecciated structure is also a local feature. The general zone-structure indicates intermittent movement over a long period during and after the processes of mineralization. Quartz of at least two distinct periods of deposition occurs in the mineralized zone-structures and a detailed study of the paragenesis of the deposit may establish an association of gold-bearing mineral-deposition with one of these periods. The carbonate stringers, veinlets, and replacements vary from white calcite to pinkish and buff ankerite, the latter largely predominating. Stringers of this mineral of both pre- and post-quartz age were observed, but the general distribution appears to suggest later deposition than the earliest quartz, and possibly in part later than the latest quartz. Cases of carbonate veins and veinlets intersecting each other are to be seen, indicating also a varying age-factor in the deposition of this material. It appears to have continued into the latest phase of mineralization. Quartz and carbonate replacement extends appreciably into the wall-rocks. Sericitization of the mineralized zones and the adjacent wall-rock is also strongly developed. Light-green micaceous areas and patches of probably fuchsite are a characteristic of the mineralized structures and altered wall-rock. The more compact mineralized zones have fairly well-defined walls, but replacement and alteration extends beyond them and gradually fades out.

The zones are mineralized with very finely-disseminated pyrite and arsenopyrite, and, locally, minor quantities of stibnite. Where stibnite occurs it is generally associated with pinkish carbonate veins, veinlets, and patches in unoxidized sections in some outcrops. It is not evident in underground exposures of the zones. Samples from discovery outcrops on the *Silver King No. 4* assayed 6 per cent. antimony; but samples from short adits about 40 to 75 feet under these outcrops showed no antimony content. In the more extensive underground workings with backs of 100 to 200 feet, stibnite is rarely recognized in the microscopic examination of polished sections and assays of samples show only traces of or no antimony. General evidence indicates stibnite to accompany the latest phase of mineralization and to diminish in quantity with depth.

Arsenopyrite and pyrite constitute the main sulphide mineralization of the zones. These occur so finely disseminated that sometimes in sections carrying good gold values the sulphides are not readily distinguished except with aid of a magnifying-glass.

The following is from "Ore Dressing and Metallurgical Investigation No. 632," by the Department of Mines, Canada:—

ARSENAL-GOLD ORE FROM WHITEWATER MINE, ON TULSEQUAH RIVER, SIX MILES NORTH OF TULSEQUAH, TAKU RIVER DISTRICT, ATLIN MINING DIVISION, BRITISH COLUMBIA.

Shipment.—A shipment of two sacks of ore marked Sample No. 1 and Sample No. 2, weighing 84 pounds and 94 pounds respectively, was received March 8, 1935. The samples were submitted by D. C. Sharpstone, Freeman Hotel, Auburn, California, U.S.A.

Characteristics of the Ore.—Samples were taken from the two lots representing the shipment, and twelve polished sections were prepared and examined microscopically for the purpose of determining the character of the ore. The two lots are identical in a microscopic character and are described as one.

The *gangue* is a dark to light green, fine textured carbonate rock, probably dolomitic, which contains stringers of white carbonate and patches of rusty to white quartz.

The *metallic minerals* noted in the polished sections are, in their order of abundance, arsenopyrite, pyrite, undetermined mineral A, pyrrhotite, and magnetite (?). Tests for undetermined mineral A are as follows:—

Colour: Grey.

Hardness: Moderately soft—C to D.

Crossed nicols: Isotropic.

Etch tests: HNO₃.—quickly tarnishes iridescent.

HCl, KCN, FeCl₃, KOH, HgCl₂.—negative.

Arsenopyrite occurs as small crystals, many of which are needle-like in form. Pyrite grains commonly have irregular shapes, but the smaller grains sometimes show crystal outlines. Undetermined mineral A is rare, occurring as small irregular grains in gangue and pyrite. An extremely small amount of pyrrhotite is present as tiny irregular grains in pyrite, and a few small grains which may be magnetite were seen in the gangue. No native gold was seen.

A quantitative microscopic analysis of the arsenopyrite and pyrite shows that the former is considerably finer than the latter. Table I. shows the grain analysis of these two minerals; the percentages are calculated by volume on the basis of 100 per cent. of arsenopyrite and pyrite combined.

Table I.—Grain Analysis of Sulphides.

Mesh.	Arsenopyrite, Per Cent.	Pyrite, Per Cent.	Total, Per Cent.
+ 65	-----	10.7	10.7
- 65+100	-----	3.9	3.9
-100+150	1.0	5.1	6.1
-150+200	6.1	4.3	10.4
-200+280	10.2	3.3	13.5
-280+400	10.5	3.2	13.7
-400+560	12.9	2.2	15.1
-560	21.5	5.1	26.6
	62.2	37.8	100.0

Calculating the relative percentages by weight, the amounts are approximately as follows:—

Arsenopyrite	Per Cent.
Pyrite	Per Cent.
	100.0

Since no free gold was seen in the polished sections, it is possible that, first, it is chiefly coarse and hence not in the sulphides; or that, second, it occurs chiefly in submicroscopic form in one or both of the sulphides. The latter is regarded as highly probable, in which case concentration of the sulphides is necessary. As will be seen by the grain analysis, the arsenopyrite is extremely fine, necessitating very fine grinding. The pyrite, on the other hand, is somewhat coarser, and can be liberated more easily.

It is not known whether the gold occurs in arsenopyrite or pyrite, or both.

Sampling and Analysis.—The two lots comprising the shipment were sampled individually and assayed for the following:—

	Sample No. 1.	Sample No. 2.
Gold	0.50 oz. per ton	0.41 oz. per ton
Arsenic	1.20 per cent.	1.72 per cent.
Iron	4.33 per cent.	4.88 per cent.
Sulphur	1.26 per cent.	2.79 per cent.
Antimony	Trace	Trace

Open-cutting and trenching through deep overburden, carried out during the Timmins option on *Silver King No. 1* and *No. 4* claims, exposed many scattered mineralized and heavily-oxidized showings, but continuity was not definitely established. In diamond-drilling, mineralized intersections with good gold values at various depths to about 200 feet below the surface were encountered, but due to faulting, not recognized at that time, correlation for depth-continuity was not established.

At elevation 660 feet in the south-east corner of *Silver King No. 4*, open-cutting and trenching along the brow of the steep bluff on the west side of Whitewater Creek expose five well-mineralized structures, 3 feet to about 8 feet wide, distributed across about 125 feet in a disturbed, shattered, and highly-oxidized formation. These may represent separate shear-zones or may be part of a wide shatter-zone striking north-easterly and dipping about 60 degrees south-east. Continuity of the zone to the south-west is probably established for 300 feet by six trenches in deep overburden which expose some sulphides and generally heavily-oxidized material across widths of 2 to 7 feet. In these trenches offsets up to about 20 feet to the south from the strike-projection of preceding exposures suggest a bending of the structure to the south or probable cross-faulting. To the north-east the structures can be traced by outcrop down the rock-slope for about 75 feet towards the creek-bottom, where slide-rock obscures further possible continuity. In the bare rock-face of the canyon on the east side of Whitewater Creek continuity is not evident, suggesting a fault in close alignment with the creek.

The central or No. 1 cut at elevation 660 feet, along the brow of the hill, exposes pyrite, arsenopyrite, and stibnite in a quartz-carbonate gangue, heavily oxidized across 8 to 10 feet. A sample across 6 feet of unoxidized vein-matter assayed: Gold, 0.8 oz. per ton; silver, 0.2 oz. per ton; antimony, 6 per cent. At elevation 625 feet, 25 feet east of this cut, an adit starting as a drift along the foot-wall side of this structure was driven south-westerly for 33 feet during the Timmins operation. At 20 feet from the portal the adit swings west through the foot-wall and away from the vein which strikes into the east wall. In this working a well-mineralized quartz-carbonate structure 5 feet wide is disclosed. At 24 feet in from the portal a sample across 5 feet assayed: Gold, 0.40 oz. per ton; silver, 0.20 oz. per ton; arsenic, 0.1 per cent.; antimony, *nil*.

At elevation 585 feet in the face of the steep bluff-slope to Whitewater Creek and 43 feet north-easterly from the old Timmins adit the present operators have driven an adit ("Canyon" adit) on the same vein (101) in a south-westerly direction. It follows the vein for 66 feet, disclosing a width of 30 to 41 inches with characteristic mineralization. At this point the vein is cut by a pronounced fault striking about north 60 degrees west and dipping 55 degrees north-east. A sample across 4 feet, 10 feet north of the fault, assayed: Gold, 0.56 oz. per ton; silver, 0.4 oz. per ton; arsenic, 0.8 per cent.; antimony, *nil*. At 66 feet in the adit swings west and continues in greenstone for 108 feet (end of July). At 85 feet from the bend 102 vein is intersected, strike north 22 degrees east, dip about 70 degrees south-easterly, 41 inches wide and well mineralized with arsenopyrite and pyrite. A sample across 41 inches on the south side of the working assayed: Gold, 0.30 oz. per ton; silver, 0.1 oz. per ton; arsenic, 1.2 per cent.; antimony, *nil*. Exploration and development of this area of the claims is proceeding.

At elevation 800 feet on the *Silver King No. 4* and about 700 feet westerly of the "Canyon" adit, a wide quartz-carbonate zone outcrops along the bluff, forming a waterfall in the canyon of Whitewater Creek. The width of this zone could not be definitely determined, but in an open-cut at the south side of the falls a width of about 6 feet of quartz-carbonate replacement is exposed. The zone strikes north-westerly and is sparsely mineralized with pyrite in blebs and fine dissemination. About 100 feet to the south-east this zone is again exposed at an elevation of 760 feet, showing heavy oxidation with quartz-carbonate gangue and some pyrite across a width of about 8 feet. These outcrops are about 2,000 feet north-westerly of the principal workings on the main north-west zone ("A" vein) at elevations of 246 and 145 feet, but cannot be correlated with this zone until further exploration has been completed.

At elevation 580 feet, about 550 feet southerly of the "Canyon" adit and about 150 feet north-easterly of the old Timmins Camp, at least two quartz-carbonate veins and several stringers are exposed in the bed and banks of Camp Creek. These are distributed across a width of about 50 feet, striking north to north-easterly across the creek and dipping about 80 degrees south-east. The structures, 2 to over 3 feet wide, are shattered, sheared, and extensively oxidized, but locally a quartz-carbonate gangue with pyrite, arsenopyrite, and stibnite is seen. Five branching and extensive trenches in deep overburden extending for 550 feet to the south of these exposures disclose heavy oxidation and several similar structures in general alignment. In some of these widths of 1.5 to 5 feet of finely-disseminated sulphide mineralization are exposed. In the main north-south trench small local and heavily-oxidized cross-structures are also to be seen. The oxidized and mineralized structures exposed in these trenches cannot be definitely correlated, but they can probably be interpreted as veins and branch veins contained in a wide north-easterly-striking fracture-zone. No development-work has been carried out on these structures, but it is understood that it is planned to extend the main workings from the "A.J." and "Polaris" adits into this area. The "Canyon" adit is about 1,625 feet north 21 degrees west from the portal of the "A.J." adit and at 339 feet higher elevation.

At elevation 440 feet, 500 feet north-easterly of the old Timmins Camp, trench 13 exposes a northerly-trending structure 6 feet wide heavily oxidized but locally well mineralized with pyrite and arsenopyrite. To the north, oxidized outcrops along a distance of 150 feet extending across Whitewater Creek can be aligned with this exposure. To the south heavily-oxidized vein-matter across a width of 10 feet probably represents the southerly continuity of this structure.

Farther south, extensive cross-trenching at intervals for 850 feet to the vicinity of the "A.J." adit exposes at least two main north-south structures with branches and junctions

and widths of 3 to 23 feet. These exposures are generally heavily oxidized, shattered, and sheared, but locally unoxidized vein-matter is well mineralized with arsenopyrite and pyrite.

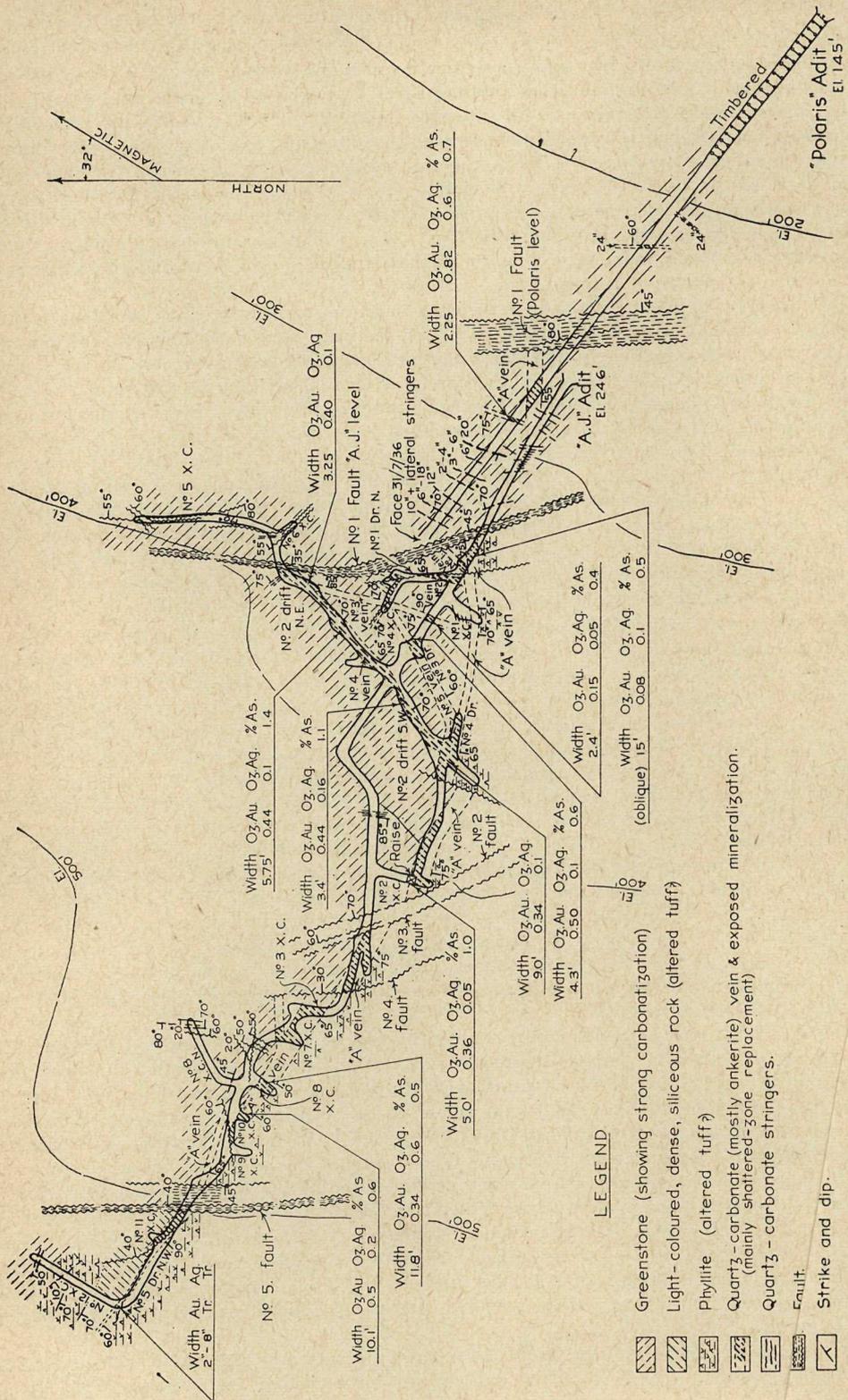
At about elevation 200 feet and 1,000 feet north-easterly from the "A.J." adit, a well-defined replacement-zone in greenstone ("Blue Bird") is exposed by open-cuts on both sides of Whitewater Creek. It strikes north 7 degrees west and is well mineralized with finely-disseminated arsenopyrite and pyrite and sparse blebs of stibnite in a quartz-carbonate gangue across an undelimited width of 4 feet. Several adjacent stringers indicate a zone-width greater than that exposed in the cuts. A sample across 3 feet of the best-mineralized section of this exposure on the south bank of the creek assayed: Gold, 3.08 oz. per ton; silver, 0.20 oz. per ton; arsenic, trace (?); antimony, *nil* (?). About 100 feet south-east a trench exposes 7 feet of highly-oxidized and shattered material that is probably the continuation of this zone. The structure has not been traced to the north-west.

It is important to note that with the exception of the most westerly of the described surface exposures, which is a north-west structure, all of the other described surface showings are north-east and north structures. The north-east and north structures exposed on the surface are on the hanging-wall side (above) of a major fault (No. 1) striking north-westerly to north and dipping 35 to 45 degrees easterly. This fault follows closely Beaver Creek, about 85 feet south-west of the portal of "A.J." adit. The surface exposures of "A" zone (north-west zone) and the underground developments on it and on zones "1," "2," "3," "4," and "5," which are north-east and north structures, completed up to the time of examination, are all on the foot-wall side (under) of No. 1 fault. The factors of displacement relative to this fault are not definitely known, and consequently a correlation of the north and north-east zones disclosed in the adit-workings, with surface exposures, could not be established. In the "A.J." and "Polaris" adits, fracture-zones containing several quartz-carbonate stringers and isolated stringers have been intersected on the hanging-wall side (above) No. 1 fault.

The "A" zone or north-west zone is disclosed in trench 24 at elevation 410 feet, adjacent to and on the south bank of Beaver Creek and 350 feet north-westerly of the "A.J." adit-portal at elevation 246 feet. In this trench a width of about 20 feet of heavily-oxidized, shattered, and sheared vein-matter is exposed, well mineralized with arsenopyrite and pyrite in unoxidized portions of the quartz-carbonate gangue. The zone strikes north 55 degrees west and dips 80 degrees south-west. The adjacent wall-rock is extensively altered and oxidized, but on the hanging-wall side can be classified as mica-schist with an adjacent felsite dyke. In trench 25, about 180 feet north-west of trench 24, a width of about 25 feet of heavily-oxidized and shattered replacement-matter is exposed, well mineralized with arsenopyrite and pyrite in unoxidized portions across a width of 14 feet on the hanging-wall side. Trench 39, about 50 feet north-west of trench 25, discloses heavy oxidation across 20 feet, with characteristic subhedral and gangue mineralization in isolated unoxidized portions. The hanging-wall rock is mica-schist with a felsite dyke adjacent to the vein. A trench in deep moraine overburden, 50 feet north-west of trench 39, is caved and flooded. Further possible surface-continuity to the north-west is obscured by heavy timber, underbrush, and deep moraine overburden. Surface-continuity down the hill south-east of trench 24 is obscured by deep moraine overburden and disturbed by No. 1 fault.

The "A.J." adit is at elevation 246 feet about 85 feet north-east of Beaver Creek and 350 feet south-east of trench 24. It was started by the Alaska Juneau Gold Mining Company and continued by it for 450 feet to No. 4 fault, with limited crosscutting and about 150 feet of drifting on No. 2 north and No. 4 north-east zones. It was continued by the present operators and at the time of examination (end of July) comprised 1,484 feet of drifting, crosscutting, and "sie-swiping," and a raise for 27 feet. The workings are shown on the accompanying plan. It is driven in a general north-westerly direction and at 105 feet intersects No. 1 fault, which strikes north 20 degrees west across the adit and dips 45 degrees east. On the hanging-wall side of the fault several quartz-carbonate stringers 2 to 18 inches wide, striking north-easterly, and one fracture-zone with quartz-carbonate stringers across a width of 15 feet, striking northerly and dipping vertically, are intersected. The greenstone contiguous to these stringers is moderately replaced with quartz and carbonate and locally mineralized with pyrite and arsenopyrite.

"A" zone, on the foot-wall side of No. 1 fault, is intersected by the "A.J." adit about 122 feet from the portal. It is explored by drifting and crosscutting for a length of 550 feet,



Whitewater Division, Polaris-Taku Mining Co. Plan of Main Workings.

showing widths of from 5 to 14 feet. It is a replacement-zone composed of shattered, sheared, and brecciated quartz and ankerite varyingly but evenly mineralized with very finely-disseminated pyrite and arsenopyrite. Sericitization and local greenish areas of fuchsite are present. A felsite dyke 6 to 12 inches wide generally follows the zone, but its relation to the zone-structure and the mineralization is doubtful. The zone strikes about north 68 degrees west and dips from 60 to 75 degrees southerly. The zone is bounded by mica-schist on the hanging-wall side and greenstone on the foot-wall side, both showing appreciable replacement. "A" zone, as exposed in the "A.J." adit, is offset short distances by several cross-faults. Towards the north-west limit of its exploration, close to its intersection by No. 5 fault, carbonate replacement with accompanying fuchsite appears to become intensified, whereas replacement with quartz and accompanying sulphide mineralization appears to diminish. In the vicinity of No. 5 fault evidence of pronounced movement is apparent, and because this probably constitutes a major fault-structure, possibly accompanied by horizontal displacement, the appreciable carbonate and limited quartz replacement, sparsely mineralized with pyrite and seemingly aligned with "A" zone, cannot be definitely correlated with it. The rock formation disclosed in No. 12 crosscut, west of No. 5 fault, differs from that east of the fault and is indicative of possible horizontal displacement.

The following samples were taken from the "A.J." adit-workings on "A" zone:—

Location.	Width.	Gold.	Silver.	Arsenic.
	Feet.	Oz. per Ton.	Oz. per Ton.	Per Cent.
End, No. 5 drift west.....	0.17-0.66	Trace	Trace
No. 10 crosscut (east side).....	10.1	0.50	0.20	0.60
No. 8 crosscut (east side).....	11.8	0.34	0.60	0.50
Raise off No. 2 crosscut (15 feet up).....	5.0	0.36	0.05	1.00
No. 2 drift, south-west (end).....	9.0	0.34	0.10
Intersection by "A.J." adit, 122 feet west of portal.....	15.0	0.08	0.10	0.50

In the raise from No. 2 crosscut, 27 feet above the level at the time of examination, a zone-width of 11 feet showing intensive replacement and well mineralized with arsenopyrite and pyrite was disclosed.

Zones "1," "2," "3," "4," and "5" in the "A.J." adit are north and north-east structures on the foot-wall side of No. 1 fault. To the south they junction with "A" zone on its foot-wall side. To the north, as with "A" zone, they are intersected by No. 1 fault and their extension on the hanging-wall side of this structure had, up to the time of examination, not been explored underground. With the exception of No. 1 zone, these structures converge towards or intersect each other in their northerly extensions. They consist of reticulated quartz-carbonate replacement, generally well mineralized with finely-disseminated arsenopyrite and pyrite in sheared, shattered, and locally brecciated structures varying from 2 to 7.5 feet wide.

No. 2 zone is the main structure in this series and has been developed for a length of 156 feet in No. 2 drift south-west and No. 2 drift north-east, between its intersection on the south-west by "A" zone and on the north-east by No. 1 fault. In this length it varies from 3.4 to 7 feet in width, averaging 4.3 feet wide. It is evenly mineralized with finely-disseminated arsenopyrite and pyrite. The following are results of samples from this structure:—

Locality.	Width.	Gold.	Silver.	Arsenic.
	Feet.	Oz. per Ton.	Oz. per Ton.	Per Cent.
No. 2 D.S.W., 12 feet south-west of main crosscut.....	3.40	0.44	0.16	1.1
No. 2 D.N.E., 40 feet north-east of main crosscut.....	5.75	0.44	0.10	1.4
No. 2 D.N.E., 75 feet north-east of main crosscut at junction with No. 3 vein.....	3.25	0.40	0.10

No. 5 zone, showing a width of 4.3 to 7.5 feet well and evenly mineralized with arsenopyrite and pyrite, is intersected by the "A.J." adit 195 feet west of the portal and 30 feet east of No. 2 zone. A sample across 4.3 feet on the north side of the crosscut assayed: Gold, 0.50 oz. per ton; silver, 0.1 oz. per ton; arsenic, 0.6 per cent. In its north-east extension No. 5 zone

joins with No. 3 zone in No. 4 crosscut, where a junction of several minor faults and slips and at least two minor mineralized cross-structures, together with the junctioning of No. 2 zone, creates a complicated condition, with the probability for an appreciable local width of mineralization.

The "Polaris" adit, driven north-west at elevation 145 feet and 285 feet south-east of the "A.J." adit, was started by the present operators in the spring of 1936. At the time of examination (July 31st) it had been advanced 420 feet in greenstone. On this level No. 1 fault is intersected at 235 feet from the portal and occupies a disturbed area about 25 feet wide, striking slightly west of north and dipping 45 degrees east. On the hanging-wall side two quartz-carbonate zones 2 feet in width are intersected. On the foot-wall side "A" zone is intersected 30 feet from the foot-wall of the fault, showing a width of about 10 feet of quartz-carbonate replacement with appreciable sericitization, light-green sections of fuchsite, and patchy mineralization with finely-disseminated arsenopyrite and pyrite. Ten feet west of "A" zone a well-defined and mineralized quartz-carbonate zone, 2.25 feet wide, strikes north-easterly across the adit. A sample of this zone across 2.25 feet assayed: Gold, 0.82 oz. per ton; silver, 0.6 oz. per ton; arsenic, 0.7 per cent.

Starting at 30 feet west of this zone, a series of seven quartz-carbonate stringers are distributed across a width of 55 feet. These stringers strike north-east, dip vertically to 70 degrees north-west, and some of them are mineralized with finely-disseminated sulphides.

Operation is continuing throughout the winter with a crew of about forty men. With the opening of river navigation in the spring of 1937, it is anticipated that over 2,000 tons of supplies and equipment will be freighted to the operation in connection with extended exploration, development, and possible production.

References to this property will also be found in the British Columbia Annual Report of the Minister of Mines for the years 1929 to 1933 and 1935; also Bulletin No. 1, 1930, "Report on the Taku River Area," and Bulletin No. 1, 1932, "Lode-gold Deposits of British Columbia." It is also referred to in the Geographical Survey of Canada Summary Report, 1930, Part A.

SILVER-LEAD-ZINC DEPOSITS.

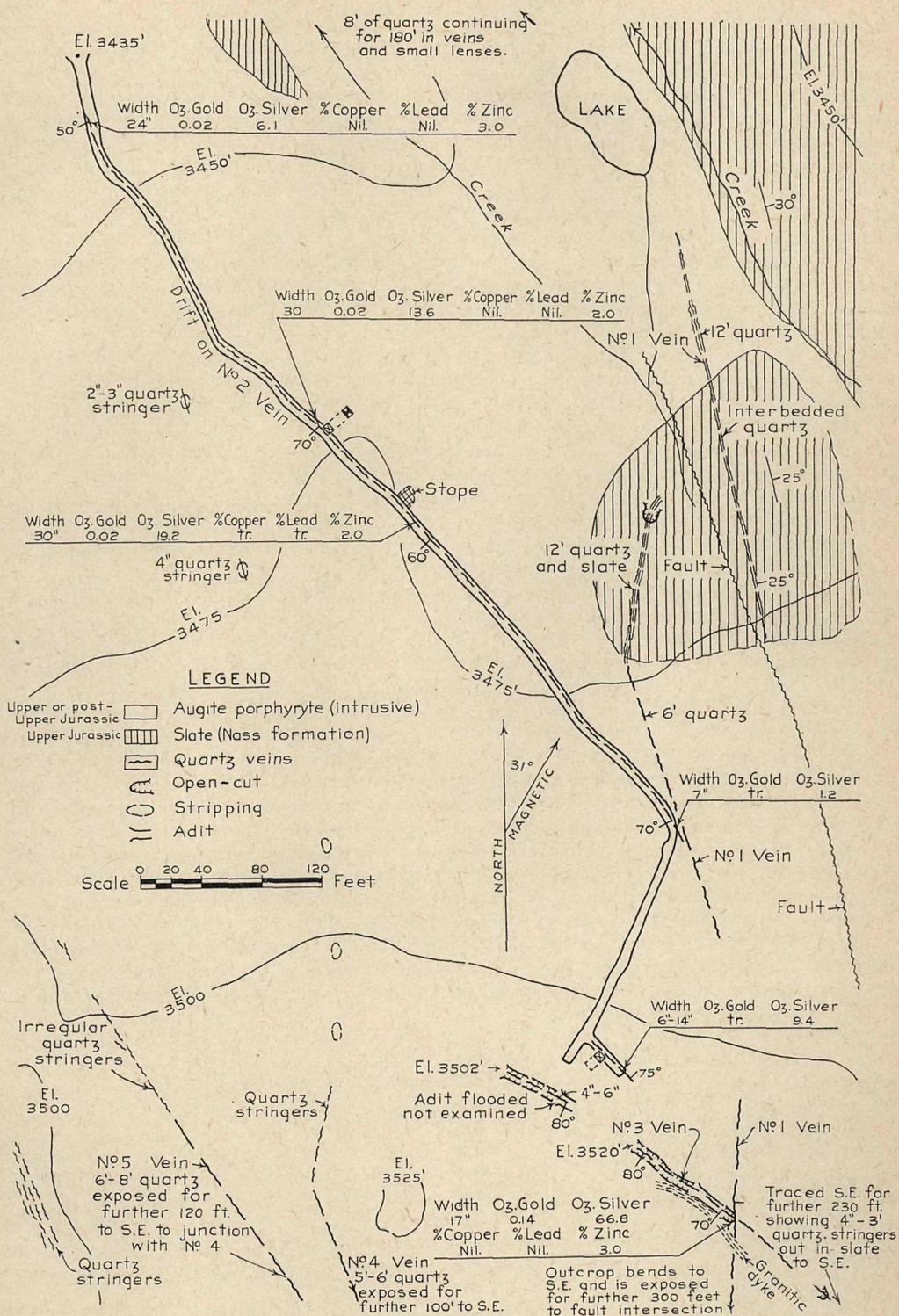
SALMON RIVER AREA, PORTLAND CANAL.

Spider. This group is owned by Theo. Collart, of Prince Rupert, and consists of the *Spider No. 1, No. 2, and No. 3* Crown-granted claims, and the adjoining *Spider Extension* group of eight claims staked in 1934 and held by location.

The property is situated on the east side of the head of Long Lake, about 3 miles north-easterly from the *Big Missouri* and about 22 miles from seaboard at the village of Stewart. It is reached by motor-road for 17½ miles to the *Big Missouri* camp at elevation 2,800 feet, and thence by trail for 3 miles through open country to the cabin at elevation 3,425 feet. The trail ascends the rock-knolled ridge north-east of the *Big Missouri* by two switchbacks of easy grade to elevation 3,500 feet on the rock-knolled west bank of Cascade Creek. This is followed along a flat, rocky bench to the north end of Long Lake, from where the trail extends along the old gravel and sand bed of the lake to the cabin.

The property was originally located in 1918, optioned to a Belgian syndicate in 1920, and in 1925 to the B.C. Bonanza Mines, Limited. It was allowed to lapse for taxes and was purchased from the Government by the present owner in 1934. Appreciable underground work, limited stripping, open-cutting, and diamond-drilling was done by the syndicate and company interests. In 1933, 1934, and 1935 the property was operated by two Stewart lessees, who mined and shipped a small tonnage of high-grade ore.

The claims are located along the lower slopes of the west side of the Bear River Ridge, between elevation 3,425 and 4,000 feet. This area is free from timber, is featured by bare rock knolls, bluffs, and ridges, with thick talus along the foot of the bluffs. The formation of the locality consists of augite porphyrite intrusive into slates and conglomerates, the whole being intersected by basic and acid dykes. Adjacent to the west, and striking across the north half of Long Lake in a north-westerly direction, dykes of mainly acidic character constitute about 75 per cent. of the formation, and form what is known as the "Belt of Dykes." The slates are correlated with the Nass formation (Upper Hazelton group) of upper Jurassic age and underlay the greatest extent of the locality, with the exception of an area 1 mile long and up to ¼ mile wide, which is occupied by a boss of intrusive augite porphyrite. The main



Spider No. 3 Claim. Plan of Geology and Workings.

mineral-showings of the group occur in the augite porphyrite and tend to disperse in small stringers on entering the slates.

The mineral deposit consists of quartz veins varying from 1 to 12 feet wide, mineralized irregularly with pyrite, galena, sphalerite, and, locally, some tetrahedrite, argentite, and native silver. The best mineralization occurs in short shoots and lenses in the narrower veins. The values are mainly in silver, with appreciable gold values in the high-grade ore. The wide quartz veins are generally barren of sulphide mineralization and strike at an angle to the narrower veins. They are siliceous replacement deposits with local lenticular development of quartz. Nos. 1, 4, and 5 veins are of this type. The narrower veins are slightly sheared fractures. Nos. 2 and 3 veins belong to this class. The replacements are exposed by natural outcrops and, with the exception of two open-cuts and some diamond-drilling on No. 1 vein, no work has been done on them. The results of the drilling are not known to the writer. The narrower veins are only exposed on surface to a very limited degree. Surface outcrops of No. 2 vein, on which most of the underground work has been done, could not be located by the writer excepting at the adit-portal. No. 3 vein is exposed at elevation 3,500 feet by an open-cut 41 feet long, continuing in an adit. In the open-cut the vein is 4 to 6 inches wide, strikes south 63 degrees east and dips 80 degrees southerly. It is irregularly mineralized with blebs and patches of pyrite, sphalerite, and galena. The adit was flooded and was not examined. At elevation 3,520 feet, 57 feet south-easterly and directly above the adit an open-cut 48 feet long, continuing in an adit 24 feet long and an open-cut 12 feet long, exposes No. 3 vein up to its junction with No. 1 vein. In these workings No. 3 vein is 4 to 18 inches wide and mineralized irregularly with pyrite, sphalerite, galena, some tetrahedrite, and, locally, some argentite and native silver. A few specks of argentite and native silver are seen in the cut at the intersection with No. 1 vein. A sample across 17 inches on the floor of this cut at the face assayed: Gold, 0.14 oz. per ton; silver, 66.8 oz. per ton; copper, *nil*; lead, *nil*; zinc, 3 per cent. To the south-east No. 3 vein has been traced along the flat crest of the ridge by natural exposure and three open-cuts for a distance of 316 feet. In this distance the vein is not well defined and shows widths of 1 inch to 3 feet of oxidized quartz stringers and decomposed vein-matter. At the south-easterly extremity the vein is intersected by a north-westerly-striking fault in a slate formation and disperses in indistinct stringers.

No. 2 vein is intersected by a drift-adit at 41 feet from the portal at elevation 3,435 feet. The vein is then drifted on for a distance of 612 feet, striking south 41 degrees east and dipping from 50 to 70 degrees south-west. In this distance the vein has the character of a shear 2 to 5 feet wide, with a lenticular and streaky quartz-filling that fades into stretches of shattered country-rock. It is mineralized along short lengths mainly with sphalerite, pyrite, and, locally, with some galena and chalcopyrite. In these sections the best mineralization occurs on the hanging- and foot-wall sides of the vein. The best mineralization occurs along the first 360 feet of drifted vein-length. For the remaining length of the drift the structure is composed of sparsely-mineralized shattered rock 2.5 to 5 feet wide, with some streaks and patches of quartz on the hanging- and foot-wall sides. At 308 feet from the portal the vein has been raised on for about 40 feet to surface. This raise was not accessible and was not examined. At 80 feet south-east of the raise the vein has been stoped for a length and height of 10 feet. In this stope some argentite and native silver was seen. The following samples were taken from the drift on No. 2 vein:—

Location.	Width.	Gold.	Silver.	Copper.	Lead.	Zinc.
	Inches.	Oz. per Ton.	Oz. per Ton.	Per Cent.	Per Cent.	Per Cent.
44 feet south-east of portal.....	24	0.02	6.1	<i>Nil</i>	<i>Nil</i>	3.0
296 feet south-east of portal.....	30	0.02	13.6	<i>Nil</i>	<i>Nil</i>	2.0
385 feet south-east of portal.....	30	0.02	19.2	Trace	Trace	2.0
653 feet south-east of portal.....	7	Trace	Trace	-----	-----	-----

At 653 feet from the portal the shear is 30 inches wide. This point is close to a possible intersection with No. 1 vein and the extension of the adit along No. 2 vein would explore the likely area of this intersection.

At 653 feet from the portal the adit swings south-westerly for 168 feet and at 146 feet intersects a parallel vein dipping 75 degrees north-east. This is drifted on for 32 feet to the

south-east, exposing a width of from 6 to 16 inches of quartz sparsely mineralized with blebs of sphalerite and pyrite. A sample of this vein across 6 to 14 inches in the face of the drift assayed: Gold, trace; silver, 9.4 oz. per ton. Midway along this drift a short raise on this vein was not accessible and was not examined.

Smelter returns on shipments by lessees from this property are as follows:—

Year.	Tons.	Gold.	Silver.
		Oz. per Ton.	Oz. per Ton.
Nov., 1933.....	3.50	1.01	294.00
Aug., 1934.....	7.67	0.23	152.18
Aug., 1935.....	3.85	0.11	113.80
Oct., 1935.....	2.568	0.54	262.64

Other references to this property are contained in the Annual Report of the Minister of Mines for the years 1919, 1920, 1922, 1923, 1925, 1933, and 1934; also in Geological Survey of Canada, Summary Report, 1919, Part B, and Memoir 132.

BEAR RIVER AREA, PORTLAND CANAL.

Palmey. This group of eleven claims and fractions is owned by W. R. Tooth, of Stewart, and is situated on the west side of the Bear River Valley, about 9 miles from seaboard at the village of Stewart. The claims are located on the steep easterly slope of Mount Stevenson, between about elevation 2,300 and 6,000 feet, and adjoin the *Dalhousie* group on the east. To the west the group abuts on the ice-field covering the crest of the Bear River Ridge. The property is reached by the Bear River Motor-road from Stewart for 8½ miles and a branch road for about half a mile to an old road-house at elevation 400 feet. From this place a pack-horse trail extends westerly across the Bear River Flats for about half a mile, where the river is crossed to its west bank by a bridge at elevation 400 feet. The trail then leads south along the foot of the steep mountain-slope for about half a mile, from where it ascends the very steep, rock-bluffed, and rugged east slope of Mount Stevenson by a series of steep switchbacks along a distance of about 1 mile to the cabin at elevation 2,500 feet. From the cabin a steep foot-trail leads up the rugged and rock-bluffed mountain-side to the showings between elevation 3,975 and 6,000 feet.

The topography of the locality is steep and rugged, the east side of Mount Stevenson, sloping from the crest at elevation 6,500 feet to the Bear River at elevation 400 feet in a distance of 1½ miles, comprising a series of vertical-faced rock ridges. The intervening talus and moraine-covered steep slopes and gullies are thickly timbered to elevation 2,500 feet, above which isolated patches of scrub timber occur to about 2,800 feet elevation.

The formation of the locality consists of agglomerates, grey, green, and purple tuffs, some porphyritic lava, and quartzitic slate of the Upper Bear River (Hazelton group) formation of probably middle to upper Jurassic age. Between elevation 4,800 and 6,000 feet is a small area of intrusive porphyritic granodiorite. The tuffs, agglomerates, and slates occur in transitional and irregular beds, striking generally northerly and dipping steeply west. An abrupt unconformity of formations in the higher elevations on the east and west sides of a pronounced gully extending northerly, diagonally across the westerly slope of Mount Stevenson, to the fringe of the ice surrounding the crest and southerly to the valley-flats, suggests a major north-south fault. A correlation of the formation on the east slope of Mount Stevenson with that on the west slope towards Monitor Lake indicates the rocks of the east slope, in the locality of the *Palmey* group, to belong to the upper horizon of the Bear River series.

The mineral deposit consists of three main quartz replacement-zones from 2 to 15 feet wide. These strike north-westerly and dip south-westerly and outcrop mainly in the tuff and slate components of the formation. They are generally conformable to the strike and dip of the formation, but the two most northerly zones converge towards each other and possibly junction at elevation 4,800 feet. With the exception of the occurrence at the highest elevation in porphyritic granodiorite, the mineralized zones are best developed in the tuffs and quartzitic slate. Locally, quartz stringers of a few inches to about 2 feet in width branch from the

main zones. Mineralization consists of sphalerite, galena, pyrite, and, locally, some chalcocopyrite, in irregular patches, blebs, and seams in a quartzose gangue.

The most northerly zone outcrops in the south-westerly corner of the *Pool* claim at elevation 3,975 feet and has been traced for about 160 feet by natural exposure and open-cuts across the bare rock bluffs, in tuffs to elevation 4,085 feet, striking north 52 degrees west and dipping 85 degrees south-westerly. In this distance the zone shows intensive quartz replacement and fair mineralization across widths of 7 to 14 feet. A selected sample of the best mineralization from a cut 14 feet wide at elevation 4,085 feet assayed: Gold, 0.03 oz. per ton; silver, 2.03 oz. per ton; lead, 13.3 per cent.; zinc, 6 per cent.

To the north-west the zone enters a greenstone-belt adjacent to quartzitic slate and is traced in this formation up a steep draw for about 108 feet to elevation 4,120 feet, striking north 38 degrees west. In this distance the zone is 4 to 5 feet wide and generally sparsely mineralized. North-west of this for about 225 feet the zone pinches to 1 to 2 feet in width with lateral stringers and disperses in tuffs at elevation 4,320 feet.

At elevation 4,250 feet the draw swings to the west and an oxidized siliceous zone, striking north 80 degrees west, outcrops along the bluff-face of the south side for 110 feet to elevation 4,400 feet, where it fades in contact with an agglomerate-bed. An open-cut on this outcrop at elevation 4,300 feet exposes a 6-foot width of quartz-calcite replacement irregularly mineralized with sphalerite, galena, and pyrite.

About 110 feet westerly of this point at elevation 4,800 feet, quartz stringers with irregular mineralization of sphalerite are scattered across a width of about 10 feet in a pyritized quartzitic slate-belt in contact with a small exposure of intrusive porphyritic granodiorite on the west. This quartzitic slate-belt is about 130 to 150 feet wide, strikes north-westerly, and to the north and along both margins of its south-easterly projection is bordered by purple and green tuffs. Along the northerly contact of the porphyritic granodiorite, striking north 30 degrees west, the quartzitic slates are irregularly mineralized with sphalerite and some chalcocopyrite. In the south-easterly projection of the quartzitic slate-belt, down the hill-slope for a distance of about 520 feet to elevation 4,700 feet, a defined structure striking north 30 degrees west and dipping about 70 degrees south-westerly outcrops at intervals, showing widths of 5 to 15 feet mineralized irregularly with blebs, patches, and seams of sphalerite, galena, and some pyrite.

At elevation 4,700 feet this structure is 15 feet wide and intensively sheared. A sample across 8 feet in an open-cut at this point assayed: Gold, trace; silver, 0.4 oz. per ton; lead, 0.6 per cent.; zinc, 2.2 per cent. To the east the slate-belt is bounded by a belt of green and purple tuffs striking north-easterly between elevations 4,500 and 4,100 feet.

About 225 feet north-westerly of this point, at elevation 5,500 feet on the *Peak* No. 1 claim, a vein 12 inches to 3 feet wide is exposed on a knob of tuff protruding from the snow. This can be traced for about 75 feet and the structure can be seen to continue in a cavern under the ice. The vein strikes north 15 degrees west and dips steeply south-westerly. It is mineralized with blebs of sphalerite and fine-grained galena. A sample of a streak of sphalerite and fine-grained galena 2 inches wide assayed: Gold, 0.02 oz. per ton; silver, 2.4 oz. per ton; lead, 7.5 per cent.; zinc, 20.5 per cent.

On the bluffs bordering this snow-field, about 165 feet to the north-west at elevation 5,645 feet, a quartz vein in a defined shear 5 feet wide is exposed in porphyritic granodiorite. A selected sample representing the best mineralization across 2 feet of the vein at this point assayed: Gold, 0.20 oz. per ton; silver, 9 oz. per ton; lead, 20.8 per cent.; zinc, 22.1 per cent. The shear has been traced up the bluffs bordering the ice surrounding the peak of Mount Stevenson to about elevation 5,800 feet. Along this distance the shear strikes north 50 degrees west, dips 60 degrees south-westerly, is from 4 to 7 feet wide, and is locally well mineralized with galena, sphalerite, and pyrite. A sample across 7 feet at elevation 5,665 feet assayed: Gold, 0.04 oz. per ton; silver, 15 oz. per ton; lead, 5 per cent.; zinc, 12.7 per cent. A sample at elevation 5,675 feet across 5 feet of quartz and calcite with some sphalerite, pyrite, and galena assayed: Gold, 0.02 oz. per ton; silver, trace; lead, trace; zinc, 1.3 per cent.

About 75 feet to the north of this porphyritic granodiorite-outcrop the contacting quartzitic slates are heavily pyritized and oxidized across a width of 106 feet for a length of about 140 feet.

These two Crown-granted claims are located on the east side of American Creek, about 2½ miles north of its confluence with the Bear River, Portland Canal Mining Division. The claims are held under lease from the Government by Sam Deschamps, of Stewart. They are reached by the Bear River Motor-road from the village of Stewart, for 14 miles to its terminus at American Creek at elevation 475 feet. From here a pack-horse trail extends for 2½ miles along the timbered and swampy bench of the east bank of American Creek to elevation 750 feet. From this point a branch pack-horse trail for about half a mile switchbacks up the steep, gullied, and timbered mountain-side to the cabin at elevation 1,700 feet. From the cabin a pack-horse trail ascends the 30-degree mountain-slope by a series of switchbacks to the workings at elevation 2,100 feet.

The claims were originally part of the old *Ketchum* group staked in 1905 by J. Lidden and J. Hinch. They were surveyed and Crown-granted in 1910, and after lapsing and being redeemed several times by various individuals, each of whom did some work, were acquired by the present owner in 1935 and 1936.

The formation of the locality consists of bedded argillite of the Bear River series (Hazelton group) of probably middle Jurassic age, striking north 50 degrees west and dipping 45 degrees north-easterly. The ore-deposit consists of a sheared vein 2 to 4 feet wide (bed-vein), conformable in strike and dip with the formation. The vein-filling consists of sheared and brecciated argillite, with veins, stringers, and patches of quartz and calcite mineralized with pockets and short lenses of massive galena, sphalerite, grey copper, and some pyrite. The vein outcrops along the northerly bluff-face of a creek-canyon, about 100 feet above the creek-bottom.

The old workings consist of a shaft at elevation 2,100 feet, inclined at 45 degrees for 54 feet, sunk on the vein, with a crosscut adit and sub-level drift at elevation 2,080 feet. From the bottom of the shaft a north-westerly drift extends 12 feet, exposing a vein 12 inches wide sparsely mineralized, but with a well-defined hanging-wall. In a south-easterly drift for 26 feet the vein widens from 2 feet to 4 feet in the face, with a well-defined hanging-wall. The vein in this face is strongly sheared, very graphitic, seamed with calcite and quartz veinlets ½ to 1 inch wide, and mineralized with seams and patches of galena, sphalerite, and grey copper 1 to 4 inches wide. A sample of this face across 4 feet assayed: Gold, 0.02 oz. per ton; silver, 40.2 oz. per ton; copper, 0.2 per cent.; lead, 5 per cent.; zinc, 8 per cent. At the time of examination the owner, with two men, was sorting high-grade ore from this face.

On the sub-level a north-west drift for 10 feet and a south-east drift for 44 feet expose a well-defined graphitic shear 2 feet wide, sparsely mineralized with streaks and patches of galena, sphalerite, and some grey copper. On the surface, at elevation 2,100 feet, 50 feet south-east of the shaft-collar, an open-cut and old stope expose the shear, well defined and oxidized across a width of 2 feet. In the face of the canyon, about 300 feet to the south-east, an old crosscut adit, reported to be 40 feet long, was inaccessible and was not examined.

At the time of examination (September 16th) about 4 tons of high-grade ore was on the dump in process of sorting and sacking for shipment. A chip sample of this assayed: Gold, 0.03 oz. per ton; silver, 322 oz. per ton; copper, 2.5 per cent.; lead, 26 per cent.; zinc, 11 per cent. About 5 tons of lower-grade material was also ready for shipment.

At 2,000 feet elevation, about 600 feet north-westerly of these workings, an old adit has been driven 40 feet on a strong fault-structure striking south 80 degrees east and dipping 60 degrees southerly. The intersection of this structure with the mineralized shear to the east should be prospected.

SILVER DEPOSITS.

KITSAULT RIVER, ALICE ARM.

This property consists of the *Dolly Varden* (Lot 3194), *Dolly Varden No. 1* (Lot 3192), *Dolly Varden No. 2* (Lot 3193), *Dolly Varden No. 4* (Lot 3195), *Dolly Varden No. 5* (Lot 3196), *Dolly Varden No. 6*, and *Dolly Varden No. 7* Crown-granted mineral claims, owned by the Dolly Varden Properties, Limited. The interest of the old Dolly Varden Mines Company was foreclosed by George Wingfield, who held a first mortgage and transferred the property to the Northern Mining Properties, Limited, which transferred it to the present owner. In 1935 the property was leased by T. W. Falconer, Alice Arm, and in 1936 this lease was renewed for a five-year term.

The property is located in the Upper Kitsault River Valley, about 18 miles from seaboard at the town of Alice Arm, Nass Mining Division, a port of call for the Union Steamship Company's coastal steamers. From Alice Arm a narrow-gauge railway extends up the west side of the Kitsault River Valley for 18½ miles to Camp 8 at 950 feet elevation. Through several years of disuse and river floods, this railway, formerly owned by the Dolly Varden Properties, Limited, had become impassable. By a special Act of the Legislature in 1935 and agreement with the company regarding non-removal of rails, the Government assumed the maintenance of the railway. Extensive temporary repair was carried out in 1936, which it is planned to complete in the early part of the 1937 season. This should place the railway in condition for light speeder traffic with about 2-ton loads. From Camp 8 a good pack-horse trail with a moderately steep grade extends up the mountain-slope for five-eighths of a mile to the working camp at 1,730 feet elevation.

The claims are situated between 900 and 2,200 feet elevation on the steep easterly slope of Dolly Varden Mountain to the Kitsault River. This mountain rises precipitously from the Kitsault Canyon to 1,600 feet elevation, then slopes at about 30 degrees to 1,850 feet elevation, from where a series of rugged bluffs extend to the crest of the ridge at 2,200 feet elevation. The property is adjoined on the north by the *North Star* claim and *James Varden* fraction; on the west by the *Silver Tip* group; on the south by the *Dandy No. 2* fraction and *David Copperfield* group; on the east by the *North Star* fraction and the *Ruby* claim. The mineral deposit occurs between 1,639 feet elevation, about 30 feet east of the easterly boundary of the *Dolly Varden No. 1* claim, and 2,200 feet elevation, about 70 feet west of its westerly boundary. The underground workings are between 1,410 feet elevation on the *Dolly Varden No. 7* claim and 1,875 feet elevation on the *Dolly Varden No. 1* claim.

The *Dolly Varden* group was staked in 1910 by Ole Evindsen and partners, of Alice Arm, and was the first location in the Upper Kitsault Valley. In 1915 the Dolly Varden Mines Company was organized by Chicago, Boston, and New York interests, and after preliminary exploration underground and limited diamond-drilling disclosed an appreciable tonnage of high-grade silver ore. In 1917 the Taylor Engineering Company, under contract to this company, entailing a profit of 10 per cent. above construction cost, commenced construction of the narrow-gauge railway to the property. The cost of this construction considerably exceeded the estimate, and litigation concerning the involved debts and acknowledgement of liability prompted legislation by the British Columbia Government, resulting in the transfer of the mine operation to the Taylor Engineering Company on the assumption of liability for the accrued indebtedness by this company.

The railway was completed in 1919 and the Taylor Engineering Company organized the Taylor Mining Company, which brought the property into production in that year. Mining of known ore for quick profit at the expense of forward development was carried on to 1921, when lack of definite ore reserves and further legal entanglements caused cessation of operations. A first mortgage on the interest of the Dolly Varden Mines Company held by George Wingfield, of Nevada, was foreclosed and the property transferred to the Northern Mines Properties, Limited. This company later transferred the holdings to the Dolly Varden Properties, Limited, which leased the property in 1935 to T. W. Falconer, of Alice Arm, who renewed the lease in 1936 for a five-year term.

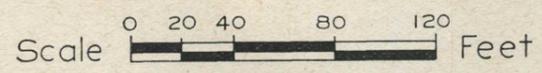
During the operation between 1919 and 1921 a total of 36,609 tons of ore, which yielded 1,304,409 oz. silver, was shipped. This was composed as follows:—

Year.	Tons.	Silver.	
		Oz.	Oz. per Ton.
1919.....	42	50,562	1,203.86
1919.....	6,668	376,562	56.47
1920.....	93	82,298	884.93
1920.....	27,944	749,340	26.82
1921.....	1,874	45,647	24.51
Totals.....	36,621	1,304,409	-----

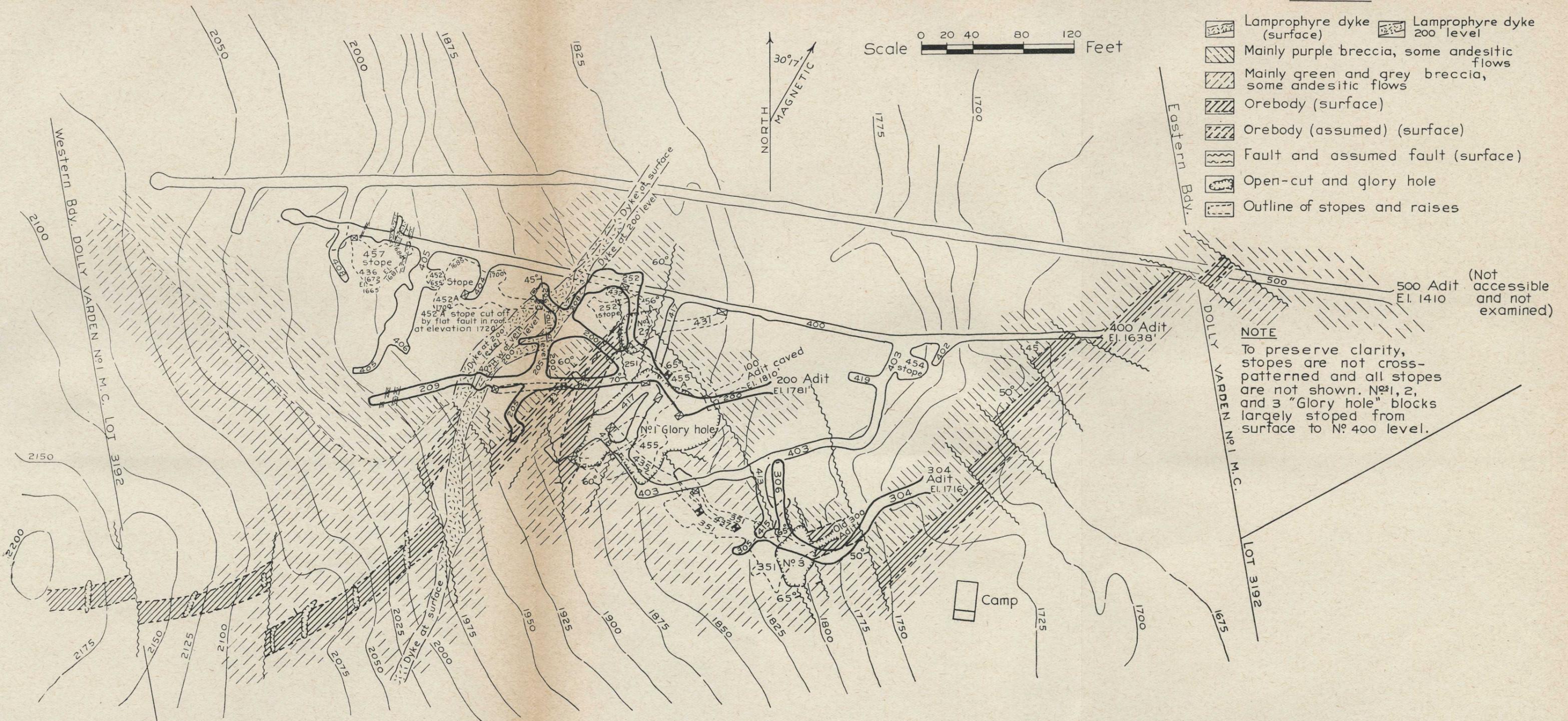
Only a small section of the known mineral deposit was mined and explored during this operation and a substantial proportion of its known extent is still unexplored or developed by

LEGEND

- Lamprophyre dyke (surface)
- Lamprophyre dyke 200 level
- Mainly purple breccia, some andesitic flows
- Mainly green and grey breccia, some andesitic flows
- Orebody (surface)
- Orebody (assumed) (surface)
- Fault and assumed fault (surface)
- Open-cut and glory hole
- Outline of stopes and raises



NORTH
30°17'
MAGNETIC



NOTE
To preserve clarity, stopes are not cross-patterned and all stopes are not shown. Nos. 1, 2, and 3 "Glory hole" blocks largely stoped from surface to No. 400 level.

(Not accessible and not examined)

DOLLY VARDEN. PLAN SHOWING SURFACE GEOLOGY AND MAIN UNDERGROUND WORKINGS.

either surface or underground workings. In the old underground workings appreciable blocks of development and partially-developed likely sections of the deposit still remain.

The property remained idle between 1921 and 1935, when the present lessee commenced mining high-grade ore from three surface exposures. In 1935 T. W. Falconer, the lessee, shipped 6.7 tons assaying: Gold, 0.015 oz. per ton; silver, 675 oz. per ton. A second shipment of 4.25 tons assayed: Silver, 1,373.93 oz. per ton. During 1936 about 700 sacks of high-grade ore was mined and will be shipped when repair of the railway is completed.

The locality is underlain by volcanic rocks of the Dolly Varden formation of over 3,000 feet in thickness. In this section these rocks occur in a belt about $2\frac{1}{2}$ miles wide and several miles long trending north-westerly across the Kitsault River Valley. On the east and west this formation is generally conformably overlain by argillaceous sediments of the Kitsault River formation.

The rocks of the Dolly Varden formation are lithologically and structurally closely related to the volcanics of the Bear River formation of the Portland Canal area to the north, and may possibly be correlated with them and, as such, with the Upper Hazelton group.

In the area of the *Dolly Varden* claims the rocks are massive and fragmental volcanics. The massive rocks are a highly-altered complex, grey to green in colour, and occupy the greatest area of the locality. Locally they contain rock fragments in a ground-mass generally exhibiting flow-structure, and can be interpreted as andesitic lava. The fragmental rocks are generally purple to reddish in colour, and composed of coarse to fine breccia in a generally coarse-textured tuffaceous ground-mass. The rocks of both types are featured by appreciable calcareous and sericitic alteration, and chloritic alteration is especially evident in the massive components. The massive and fragmental rocks are generally irregularly distributed and are transitional into each other. No regular structural relationship between the components of the complex is evident. In the area of *Dolly Varden No. 1* claim, in which the greatest known extent of the mineral deposit occurs, the lower elevations of Dolly Varden Mountain to the Kitsault Canyon are underlain by mainly the purple fragmental component, and the grey and green massive and in part fragmental rocks occupy the higher elevations. In places, on this claim, contiguous to the mineral deposit the purple fragmental rocks appear to overlay the grey and green massive rock with a northerly dip, conformable to the mineral deposit. This, however, could not be established as a general condition.

The mineral deposit is a siliceous replacement-zone from 8 to 25 feet wide, striking north 60 degrees east and dipping 50 to 60 degrees north-westerly. Quartz constitutes about 70 per cent. of the zone-filling and is generally best developed on the hanging-wall. Calcite and jasper occur locally but are uncommon, while barite sometimes occurs, more frequently in the deeper horizons, but is generally rare. The valuable mineralization of the zone consists mainly of silver-bearing minerals and the deposit is consequently classified as essentially a silver-mineral deposit. This mineralization consists mainly of argentite, ruby silver, and native silver, generally accompanied by appreciable quantities of pyrite. Grey copper (probably tetrahedrite) sometimes occurs but is not common. Sphalerite, galena, and chalcopryrite are rare in surface outcrops and in the upper levels of the underground workings, but show a decided tendency to increase in the deeper horizons, with an accompanying decrease of the high-grade silver minerals, especially in No. 4 adit-level. In the surface and upper workings the native silver frequently occurs in irregular coarse masses and platy seams, often in contact with and originating from argentite. In the deeper levels it decreases in quantity and occurs generally as thin and small flakes or very fine wires. In the surface and upper workings ruby silver occurs in masses and seams up to an inch or more in diameter, but in the lower horizons occurs locally, generally in small blebs, finely disseminated or in thin filaments. The surface and upper horizons of the zone are moderately oxidized in varying degree. The high-grade silver mineralization of the zone is indicated to be essentially secondary and resultant from enrichment of the structure by supergene solutions. Although values in depth appear to diminish, the depth to which this enrichment penetrated in the zone is not known. The degree of distribution of primary minerals and the values contained in them below the horizon of secondary enrichment is also not known.

Along the hanging-wall the zone is frequently very well silicified across a width of 4 to 6 feet and in such sections constitutes a dark-coloured high-grade pay-streak, with secondary silver minerals disseminated in the altered and sheared hanging-wall rock. In some sections

of the mined area portions of this siliceous streak have been left in the hanging-wall of stopes. The hanging-wall of the zone is generally well defined, but the foot-wall lacks definition and replacement is transitional.

The zone is exposed by open-cuts, stripping, and natural exposure for an outcrop-length of about 1,050 feet, striking generally between east-west and about north 20 degrees east, and dipping from 45 to 60 degrees north-westerly, in at least thirteen main and several minor faulted blocks from about 30 to 170 feet long on the surface. The faults appear to be both normal and reverse, striking generally between north and north-westerly and dipping from about 50 to 60 degrees south-westerly. Flatly-dipping to nearly horizontal faults are also seen underground, the best example observed being on the roof of 452A stope off the 400 adit-level. On the surface a horizontal fault striking nearly conformably with the zone is indicated west of No. 2 glory-hole in the section known as the "Missing Block." The age-sequence of the faults varies, but the normal and horizontal faults appear to be minor faults within blocks previously offset by reverse faults. The horizontal offsets along the faults varies from about 15 to about 150 feet and the vertical displacement does not appear to have been very great.

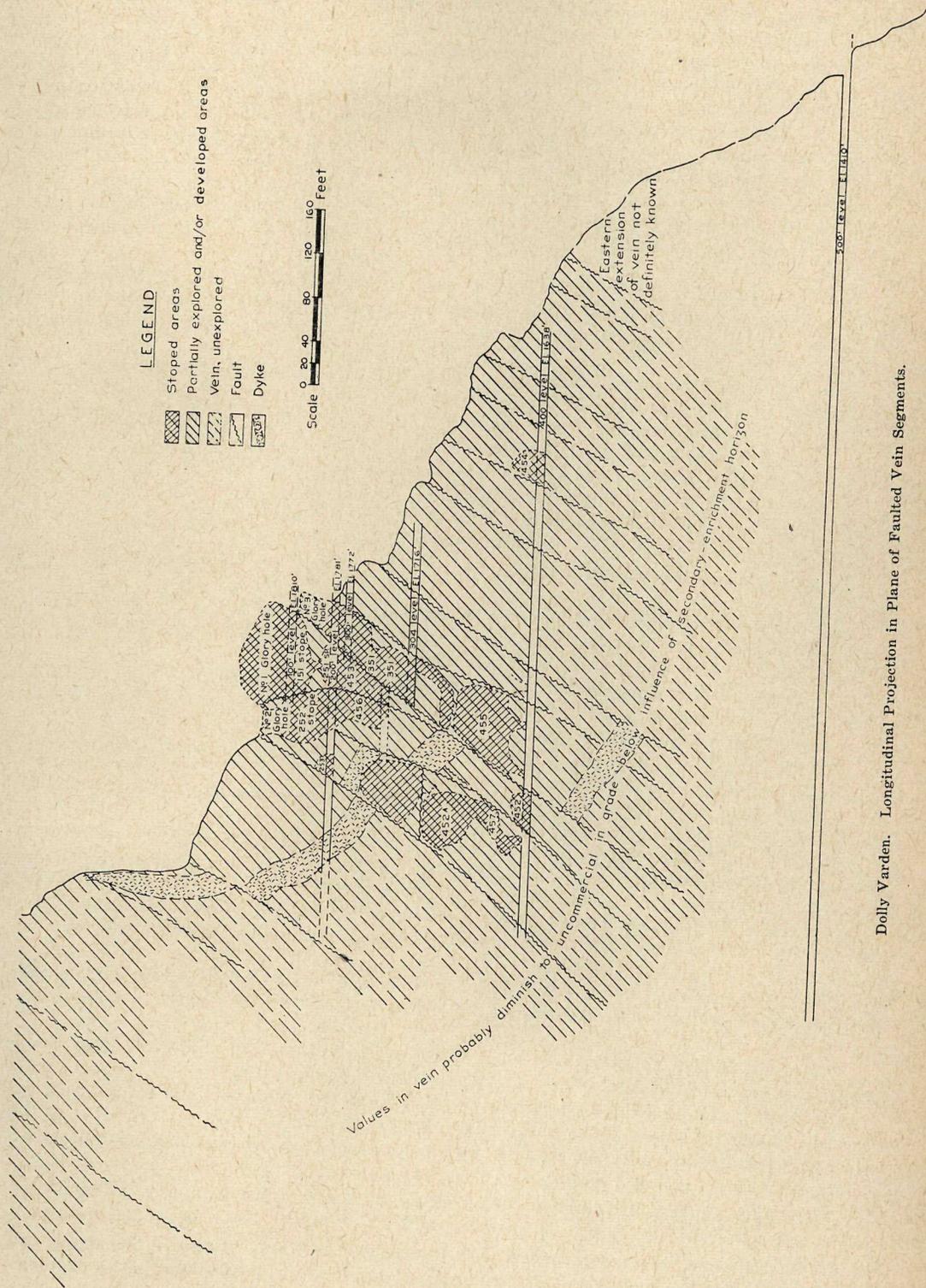
The easterly 650 feet of the zone outcrops along and adjacent to the contact of the purple fragmental rocks with the green, massive, and partly fragmental volcanics. At the westerly extremity of this length the contact swings sharply north-west and the westerly 400 feet of the zone outcrops in the green, generally massive rocks. No change in definition or width of the zone-structure is evident in the surface tracing in these two types of rocks. The old open-cuts and stripping are generally caved and overgrown with brush, but silicification and oxidized zone material is still evident in them. Cuts and stripping along the westerly section of 400 feet indicate a zone-width in this locality from 18 to 20 feet. Continuity of the zone to the west of the most westerly exposure on the *Dolly Varden No. 2* claim at 2,200 feet elevation is obscured by overburden, underbrush, and timber. There is, however, nothing to indicate that the zone does not continue to the west beyond this point with probably a recurrence of the characteristic cross-fault offsets.

At the easterly extremity of the surface-tracing the zone is cut off by a fault and its continuity easterly beyond this point is not definitely known. Similar structures, but with a slightly different character of mineralization, occur on the adjoining *North Star Fraction* and in comparative alignment on the *Toric* and *Tiger* groups, several thousand feet to the north-east, on the east side of the Kitsault River. Whether these occurrences represent the north-easterly continuation of the *Dolly Varden* zone will require further investigation.

Only the central section of the *Dolly Varden* zone has been mined in four main faulted blocks for a total strike-length of about 320 feet and a vertical depth of 237 feet. Of the remaining 730 feet of known zone-length the easterly section, 360 feet long, composed of six fault-blocks, has been crosscut by the 400 adit and probably by the 500 adit (not examined), but, with the exception of the small 454 stope off the 400 level, has received no further underground exploration or development. Four horizontal and two minus 10-degree diamond-drill holes were drilled from the surface at 1,640 feet elevation, 24 feet south-westerly from the 400 adit-portal and fanned out between south 69 degrees west and north 56 degrees west. These should have intersected the four westerly blocks of this easterly section of the zone. The details of this drilling are not known to the writer and there is no evident reason to indicate that mineralization similar to that encountered in the workings to the west may not also occur in this easterly section, especially in the vicinity of the cross-faults.

The four fault-blocks of the extreme westerly section of the known zone-length are totally unexplored underground and no surface diamond-drilling is known to the writer. It is also very doubtful that diamond-drilling done from the faces of the 400 and 500 adit-levels has intersected any possible depth-continuation of these fault-blocks. There is no evident reason to indicate that these blocks, especially in the upper horizons and in the vicinity of the cross-faults, may not contain mineralization similar to that occurring in the workings to the east.

The central section of the zone was opened up by six adits at respectively 1,810, 1,781, 1,772, 1,716, 1,638, and 1,410 feet elevation. These are shown on the accompanying plan and longitudinal projection. Three fault-blocks were stoped through to surface in Nos. 3, 1, and 2 glory-holes, but small portions of the zone with high-grade silver mineralization still remain unmined in and around the glory-holes at the surface.



Dolly Varden. Longitudinal Projection in Plane of Faulted Vein Segments.

Shipping-grade ore is being mined from three of these localities by T. W. Falconer, the present lessee. In No. 2 glory-hole, below the 200 adit-level, a width of 3 to 4 feet of the siliceous hanging-wall streak still remains on the "back" of the stope and the same condition was observed in several of the old stopes. Native silver, argentite, and ruby silver were observed in some of these sections in the workings. Of interest in this respect is the occurrence of flaky native silver observed in a section of the siliceous hanging-wall streak on the "back" of 452A stope, indicating the persistence to this depth, although possibly subdued, of secondary enrichment. The gradual diminution of secondary enrichment mineralization in depth is suggested in 436 and 457 stopes, the most westerly stoped area from the 400 level. The zone in these workings is deficient in the decided secondary alteration characteristics evident in the workings of the upper horizons and is mineralized essentially with the primary sulphides, sphalerite and galena, with comparatively low silver values. (See sample and assay No. 11.)

The depth to which the influence of secondary enrichment extends in the zone is not known. Whether the quantity and value of the purely primary sulphide mineralization in the zone below the horizon of secondary enrichment is sufficient to return a profit on mining is also not definitely known.

Examination of the accessible adit-levels, stopes, and raises above the 400 adit-level indicates appreciable likely portions of the zone still remaining in the underground workings. Detailed surveying and sampling is required to definitely establish the tonnage and probable value of these developed and partially-developed blocks. They are indicated in the accompanying longitudinal projection and a rough estimate shows about 10,000 tons of developed and partially-developed zone still remaining in the mined section above the 400 adit-level. Detailed sampling may reveal some of this to be of commercial milling-grade and some ore of shipping-grade may be encountered, especially above the 304 adit-level.

To ascertain possible values in this section of the workings the following samples were taken:—

(1.) Across 7 feet, fault-block on west side of No. 1 glory-hole, foot-wall, surface, mineralized with pyrite, native silver, ruby silver, argentite, and some sphalerite: Gold, trace; silver, 81.6 oz. per ton; copper, *nil*; lead, *nil*; zinc, trace.

(2.) Across 8 feet, hanging-wall side, west side of No. 2 open-cut, west side of No. 2 glory-hole, mineralized with pyrite, ruby silver, native silver, and some sphalerite: Gold, trace; silver, 38.4 oz. per ton; copper, *nil*; lead, *nil*; zinc, 4 per cent.

(3.) No. 2 open-cut, west side of No. 2 glory-hole, foot-wall side of zone, across 4 feet; Gold, trace; silver, 45.2 oz. per ton.

(4.) No. 2 cut, west side of No. 2 glory-hole, across 4 feet south-west side of face, hanging-wall side of zone: Gold, 0.01 oz. per ton; silver, 24 oz. per ton.

(5.) No. 3 open-cut, 40 feet south-westerly of No. 2 glory-hole, face and 6 feet of both sides of adit 15 feet long from end of cut, mineralized with argentite, ruby silver, native silver, pyrite, and some sphalerite: Gold, trace; silver, 46 oz. per ton.

(6.) Raise, 15 feet east of No. 3 cut, east side of raise for 10 feet down from collar, representing width of about 4 feet on hanging-wall side of zone: Gold, trace; silver, 27.3 oz. per ton.

(7.) No. 1 open-cut on east side of No. 2 glory-hole, across 14.1 feet of zone in face and floor of cut, mineralized with argentite, ruby silver, native silver, and pyrite: Gold, trace; silver, 158 oz. per ton.

(8.) Adit, 21 feet, in west side of No. 2 glory-hole, 10 feet north of and 5 feet below No. 2 open-cut, along 21 feet of east side: Gold, trace; silver, 6.6 oz. per ton.

(9.) No. 2 glory-hole, 252 stope, north-west side at 208 drift adjacent to dyke, across 3 feet in "back" of stope: Gold, trace; silver, 13.5 oz. per ton.

(10.) Two hundred adit, 206 crosscut, face and east side, east of fault and north of dyke: Gold, trace; silver, 14.5 oz. per ton.

(11.) Four hundred and thirty-six stope off westerly end of 400 level, selected sample of galena and sphalerite mineralization in zone: Gold, trace; silver, 26 oz. per ton.

T. W. Falconer, the present lessee, with three men has been mining shipping-grade ore from Nos. 1, 2, and 3 open-cuts and also from the north side of the entrance to No. 1 glory-hole. An ore-bunker at the railway at Camp 8 and an aerial tramway from the workings has also

been constructed. An assay plant has been installed and during the winter months the surveying and sampling of the underground workings is being carried out with the objective of ascertaining the tonnage and value of zone sections left in these workings.

PLACER-GOLD DEPOSITS.

ATLIN AREA.

Field-work in the Atlin section during the 1936 season had as its main objective the detailed study of Pine and Spruce Creeks for the purpose of outlining the old channels and establishing their continuity and location.

The Atlin placer-gold area is situated in the north-west corner of the Province, in the Atlin Mining Division. It is located between latitude 59 degrees and 60 degrees north and longitude 133 degrees and 134 degrees west. Atlin Lake occupies a deep north-south trough along the west side of this quadrant. The lake is 65 miles long and varies from 1½ miles wide at its north end to 6½ miles wide in the south part, where the West Channel, also constituting a long, narrow, branching waterway, is 25 miles long and about 1¼ miles wide. The north end of Atlin Lake extends across the 60th parallel of latitude for 2 miles into Yukon Territory. The town of Atlin is located on the east shore of Atlin Lake, 30 miles south of the Yukon boundary.

The area is reached by regular and frequent steamship service from Prince Rupert, Vancouver, and United States Pacific ports to Skagway Alaska, a distance of about 420 miles north-westerly from Prince Rupert and about 1,085 miles north-westerly from Vancouver. From Skagway a regular service is supplied by the White Pass and Yukon Railway to Whitehorse. From the town of Carcross, Y.T., 55 miles north-easterly of Skagway on this line, steamers are operated during the summer by the White Pass Company on Tagish Lake to Taku Landing, about 71 miles south-east of Carcross. At Taku Landing a transfer is made via 2½ miles of railway to Scotia Bay on Atlin Lake, which is crossed by boat to Atlin. Summer freight-rates on commodities from Prince Rupert, Vancouver, and Victoria to Atlin vary from \$51 to \$66 a ton for car-load lots. The rates for machinery to Atlin are \$51 a ton for car-load lots and \$56 a ton for less than car-load lots. Generally, the rate for less than car-load lots varies from \$74 to \$103 a ton. For ore in sacks, not exceeding a value of \$100 a ton, the rates from Atlin are \$8.25 a ton for car-load lots and \$9.25 a ton for less than car-load lots. In winter months Atlin is accessible either by aeroplane from Juneau, Alaska, or Carcross, or by dog and horse teams.

Development of the Atlin area has been handicapped by this roundabout but unavoidable means of access, attended by high transportation costs. To facilitate access to the area by aeroplane the Dominion Government established a Canadian Customs office at Atlin during the 1936 season.

History.—Before 1898 very little was known of the Atlin country beyond the fact that it contained fur, big game, and a number of large lakes, the largest of which was called "Atlin," meaning "Big Water," by the Tlinkit-Tagish Indians. According to the most authentic sources, gold was first discovered on Pine Creek about July, 1897, by a man named Miller when driving cattle into Dawson. The information, together with a rough map, was passed on to Miller's brother, Fritz, in Juneau, who together with Kenny McLaren, a Canadian prospector, Hans Gunderson, and another, were on their way to the Klondike. These men decided to investigate and with the aid of the map were able to locate the creek with little difficulty and staked the first claims about July 8th, 1898. Public information concerning the new strike reached Alaskan ports on August 5th, and Victoria, B.C., on August 13th, 1898, and resulted in a rush to the area. By the close of the season it was estimated that over 3,000 people were in the new field and many of the principal gold-bearing creeks were staked, including Spruce Creek, the main tributary of Pine Creek, and probably the most important gold-bearing creek of the area. The first claims were staked on Spruce Creek in 1898 by Fred Marius, who reported good values from workings on the high rim around the mouth of Eureka Creek, a small tributary on the south side of the lower section.

It is interesting to note that when the camp was discovered it was claimed by the Mounted Police for the North-west Territories and the first claims were staked (250 feet long) under the laws of that Territory. Subsequently it was ascertained that the area was in the Province of British Columbia and claims were required to be staked 100 feet long, under the laws of the

Province at that time. This caused chaos, but, to the credit of the camp, no disorder, and the many disputes were finally settled in 1899 by Mr. Justice Irving.

It is recorded that a noticeable feature of early operations in the Atlin Camp was the lack of experienced miners. This important feature explains many otherwise inexplicable aspects of former operations and their bearing on the varied progress of the area. Only the more evident "pay-dirt" along confined widths was worked by individuals, and much work was done in unfavourable sections. On Pine and Spruce Creeks large company operations using expensive and unsuitable plants were started before sufficient prospecting, drilling, or geological investigation had been done. For these reasons only partial recovery was made from some ground, but now the condition of certain old workings makes further recovery expensive or impossible. For the same reasons, many opportunities also exist in the Atlin area to-day on both old and virgin ground in practically unworked creeks and in pay-channel extensions on creeks such as Pine and Spruce. This aspect promises appreciable expansion in placer-mining activity in the Atlin area.

Since the discovery of the Atlin Camp there has been an appreciable but fluctuating placer-gold output. Although figures of production from each individual creek are not available, a study of records indicates that a large proportion of the total production has come from Pine and Spruce Creeks. The most substantial large-scale operations of the area were carried out on Pine Creek, where individual claims began to be absorbed by company interests in 1901, which continued large-scale operations to the commencement of the decline in 1917. Spruce Creek has been worked mainly by individuals, with a few minor company operations, since its discovery.

The recorded placer-gold output from Atlin is as follows:—

Year.	Oz.	Value.	Year.	Oz.	Value.
1898, discovery of camp	3,750	\$75,000	1918	10,725	\$214,500
1899	40,000	800,000	1919	8,450	169,000
1900	22,500	450,000	1920	6,750	135,600
1901	15,000	300,000	1921	6,930	138,600
1902	20,000	400,000	1922	6,930	138,600
1903	22,000	440,000	1923	7,570	156,500
1904	26,500	530,000	1924	8,647	147,000
1905	23,750	475,000	1925	2,896	49,229
1906	22,750	455,000	1926	2,607	44,318
1907	20,400	408,000	1927	2,428	41,276
1908	10,150	203,000	1928	3,174	53,958
1909	10,000	200,000	1929	2,408	40,936
1910	13,750	275,000	1930	3,141	53,397
1911	11,250	225,000	1931	3,334	142,528
1912	14,500	290,000	1932	8,040	155,684
1913	15,750	315,000	1933	11,299	265,751
1914	16,100	322,000	1934	10,039	284,832
1915	18,850	377,000	1935	13,227	382,797
1916	16,925	338,500	1936	18,423	530,726
1917	15,250	305,000			

The Atlin placer-gold area lies on the eastern margin of the Coast Mountains bordering the south-easterly extension of the Yukon Plateau. These two bordering and contrasting physiographic provinces merge into each other across a comparatively narrow transitional belt.

The characteristic ruggedness of the Coast Mountains is exemplified in an irregular complex of serrated peaks, of 7,000 to 8,500 feet elevation, some domed ridges of lesser altitude, steep, bluffed slopes to deeply-eroded and heavily-timbered valleys, extensive snow and ice fields, glacier cirques and glaciers extending to the heads of the valleys. The Transition Zone, which embraces the Atlin section, is a mature upland surface, dissected by deep, wide valleys flanked by generally dome-crested mountain ridges and ranges of 4,000 to 6,000 feet elevation, with steeply-sloping and locally truncated sides. The valley-bottoms, terraced, rolling, and drift-filled, are lightly timbered with black pine, balsam-fir, white and black spruce, aspen and balsam poplar, willows, alder, and dwarf birch. The best timber is patchy and averages from 12 to 18 inches in diameter. Berries of various kinds are plentiful and a profusion of northern and alpine flowering plants and shrubs grow in the valleys and on the mountain slopes and crests.



LEGEND

- Rim-rock & bed-rock outcrops mainly, serpentine, greenstone, schist, quartzite, slate & limestone
- Rim-rock slope
- Drift workings
- Shaft
- Indicated rim boundaries of old-channels
- Approximate boundary of post-glacial lake

Scale 0 1500 3000 4500 Feet

NORTH MAGNETIC 32°30'

PINE CREEK AND SPRUCE CREEK, ATLIN. PLAN SHOWING PLACER-GOLD AREAS.

Geology.—The rocks underlying the Atlin area consist of a very irregularly-distributed complex of varied lithological character. This complex condition is responsible for extreme variations in short distances, in texture and hardness of the bed-rock, and consequently requires detailed investigation for correct determination of the most suitable placer-mining methods. Most widely distributed in the area is a series several thousand feet thick composed of grey and black slates in part micaceous, limestone, quartzites, and cherty quartzites. The bed-rock of the upper section of Spruce Creek is composed of these rocks. In the O'Donnel River area these rocks are also widely distributed together with appreciable limestone areas. Next in age sequence is a series of hornblende-schist, pyroxenite, peridotite, serpentine, greenstone, and magnesian rocks comprising the so-called "Gold series." These rocks occupy the lower and central section of Spruce Creek Valley and the entire lower section of Pine Creek Valley between Surprise Lake and Atlin Lake. These rocks, although varying in hardness, are generally weathered, friable, and soft, locally of a clayey character. When they are not intruded by hard dyke-rocks they are well adapted to bed-rock placer-mining. These various rock formations are intruded by stocks and bosses of granitic rocks, satellitic to the Coast Range batholith. Such intrusives largely comprise the Fourth of July Valley area and exposures extend south-easterly to the higher elevations of Munro Mountain. There is also an extensive exposure of granitic rock occupying both sides of practically the entire Surprise Lake area. It does not form, however, any part of the Pine Creek valley-floor between Surprise Lake and Atlin Lake, or of Spruce Creek Valley. Hard and compact granitic and felsitic dykes invade these various formations throughout the area, and are frequently exposed striking north-westerly across Pine Creek, but are not so frequently seen in the Spruce Creek section. In the Ruby Creek area, west of the Lower Surprise Lake section and in the adjacent Volcanic Creek area to the west, a bed of late Tertiary basalt occurs. This originates from an extinct crater situated at the head of Ruby Creek. Locally, cemented gravel deposits occupy the preserved beds of pre-Pleistocene creeks and rivers. Overlying these and flooring the valley-bottoms are superficial accumulations of glacial drift and aqueoglacial gravel, sand, and clay deposits, locally up to about 200 feet in thickness. Bed-rock and rim-rock, however, frequently outcrops through these superficial deposits. A thin layer of soil covers the surface of the area, excepting on steep mountain-slopes and bluffs and rock-knolled mountain crests.

PINE CREEK.

General.—Pine Creek occupies a trough extending south-westerly for about 30 miles from the headwaters of Boyd Creek, through Surprise Lake to Atlin Lake. Boyd Creek, which drains into Surprise Lake, is deeply incised in a low, thickly drift-covered divide to Consolation Creek. Surprise Lake, elevation 3,160 feet, is about three-quarters of a mile wide and $1\frac{3}{4}$ miles long. Its upper section is confined between precipitous bluffs of granitic rocks that rise abruptly to the bare mountain-crests of 4,500 to 5,000 feet elevation. Towards the southerly end of the lake the valley-floor flattens to gentle hillocked slopes deeply covered by glacial drift and bordered by steep slopes of the confining mountains.

Pine Creek proper occupies a trough about 12 miles long draining from the southerly end of Surprise Lake into Atlin Lake at elevation 2,200 feet. The valley is about $2\frac{1}{4}$ miles wide between the confining steep slopes of Munro Mountain on the north and Bald Mountain on the south. The valley-floor is deeply buried by glacial drift to about 3,300 feet elevation in the Surprise Lake section and to 2,900 feet elevation 7 miles south-westerly from the lake. In the upper 3 miles of this stretch deep glacial drift extends across a width of about $1\frac{3}{4}$ miles. In the central 4-mile stretch the deep drift covers a width of about three-quarters of a mile. At about 7 miles from Surprise Lake and continuing for about 4 miles to the mouth of Pine Creek the valley "fans out" to a wide, flat expanse floored with lacustrine deposits through which a few rock knolls and low ridges outcrop. With the exception of the rock canyon at "Halfway," about $3\frac{1}{2}$ miles from its mouth, the rocky section of "Stevendyke," about $1\frac{1}{2}$ miles above "Halfway," and a rocky area three-quarters of a mile long about $3\frac{1}{2}$ miles below Surprise Lake, Pine Creek has incised its course mainly through deep glacial and aqueoglacial deposits.

A series of sloughs and small lakes characterizes the upper end of Pine Creek in the neighbourhood of Surprise Lake and the mouth of Birch Creek. In the lower section the creek-bed is from 40 to 80 feet wide. In the lower $4\frac{3}{4}$ miles of its course the creek-gradient

is about 2 per cent.; in the central $4\frac{1}{4}$ miles it is about 1.5 per cent.; and in the upper $2\frac{1}{2}$ miles to Surprise Lake the creek has a flat gradient of slightly less than 1 per cent. The valley-floor is lightly timbered in the lower section with hemlock, spruce, fir, birch, and willow, with comparatively light underbrush. In the central section up to the south end of Surprise Lake the valley-floor is lightly carpeted with mainly small willow-bushes and underbrush. The best timber occupies a belt along the foot of the steep slopes of Munro and Bald Mountains from 150 to 300 feet above the creek-trough. A good motor-road extends from the town of Atlin to Surprise Lake and along the north shore of Surprise Lake to Ruby Creek, a distance of 16 miles. Branch roads extend up Birch Creek on the north side of Pine Creek and up Boulder and Ruby Creeks on the north side of the lower end of Surprise Lake. A branch road also extends to the central section of Otter Creek and crosses to the upper section of Wright Creek on the southerly side of the lower end of Surprise Lake. On the north side of the lower end of the valley, roads also branch to Trond Gulch and to Como Lake and Fourth of July Creek. On the south side a branch road extends up Spruce Creek for a distance of $4\frac{1}{2}$ miles from the Pine Creek Road. A high-bench road also extends to the headwaters section of Spruce Creek.

History.—Gold was discovered on Pine Creek a short distance east of the present site of the old town of Pine City ("Discovery") in 1897, and news of this reached the "outside" in the early autumn of 1898. In that year about 3,000 people rushed in and about \$75,000 was produced. In 1899 the creek was staked along its entire length from Surprise Lake to Atlin Lake and gold-bearing gravel had been found from slightly below Discovery claim to about 1 mile above, and it is recorded that no work was done above or below these points. On account of the small 100-foot claims allowed under the mining laws of that period and the refusal of claim-holders to permit dump-space on their ground to adjoining claim-holders, the limited work done was mostly confined to the creek-bed and very few benches were worked. For the same reason, coupled with the flat creek-gradient, operations were severely handicapped by drainage difficulties and high-water washouts were frequent. Several shafts were also sunk in the bench of Pine City through blue glacial clay, but these workings were flooded before bed-rock was reached. In 1899 it is estimated that 640 men were working and about \$95,872 was expended on construction of wing, tail, and head dams, sluice-boxes, water-wheels, pumps, etc., and despite the difficulties encountered, an output for the camp of 40,000 oz. gold, valued at \$800,000, the highest yearly output in the history of the Atlin Camp, is recorded, the bulk of this being produced from Pine Creek.

In 1901 miners began leaving for the Yukon, individual operations declined, and claims began to pass to the hands of hydraulic companies. Drifting operations on "Gold Run" and Pine Creek are recorded as not being remunerative except at the mouth of "Gold Run," where exceptionally good values were encountered. These values prompted the conception at that time that the "gold run" of Pine Creek came from the area known as "Gold Run" on the south side of Pine Creek, and that the continuation of the gold-bearing channel must be sought along the small trough of Gold Creek ("Gold Run"). Regardless of the apparent structural evidence contradictory to this supposition, much shaft-sinking and drifting, even the installation of an expensive dredge, has been done in the "Gold Run" area in the unsupported belief of the existence there of the continuation of the old gold-bearing channel of Pine Creek. Strangely, that belief is still held by many in the Atlin Camp, or it has been assumed that at this point on Pine Creek, for some unknown reason, the gold-bearing old channel is "lost," has suddenly stopped, or has been obliterated. There is no doubt that a small meandering gold-bearing channel does exist along "Gold Run" and the high values at this point on Pine Creek can be ascribed to the junctioning of this channel with the Pine Creek channel. The structure governing the continuation of the old channel of Pine Creek under the bench of the north side of the creek will be discussed under the heading of "Geology."

In 1901 the Atlin and Willow Creek Mining Company commenced operation, extended construction of ditches, flumes, etc., and installed a boiler and steam-pump. Other companies preparing for operation were Sunrise Hydraulic Mining Company, Pine Creek Power Company, and Stevendyke Hydraulic Syndicate.

In 1903 the British-American Dredging Company, Limited, acquired property, imported a Keystone drill, expended about \$20,000 for drilling on "Gold Run," and brought in a Bucyrus dredge and an elaborate Stillwell-Bearce electric-power plant rated at 500 horse-power. The

power plant was installed a short distance below "Halfway"; ditches, flume, power-line, dams, camps, etc., constructed at a cost of about \$300,000 and the dredge placed on "Gold Run." This dredge was an open-connected link-and-pin type with 96 buckets of 3 cubic feet and a capacity of 2,500 cubic yards per day under favourable conditions. Gold-saving tables were carried on a separate scow in tandem with the dredge. During this year J. M. Ruffner, to whose energy can be credited much of the placer and lode activity in the Atlin area up to the time of his death in April, 1929, commenced hydraulicking operations with the North Columbia Gold Mining Company. The Eastern Hydraulic Mining Company also inaugurated hydraulicking on the south side of Pine Creek above "Discovery."

In 1904 the British-American Dredging Company, Limited, operated its dredge on "Gold Run" intermittently. Much trouble was encountered in attempts to dig the tenaciously clay-cemented gravel, especially where it was bouldery. To loosen the ground, blasting in Keystone-drill holes ahead of the dredge was resorted to. Break-downs were frequent and before the season closed the bucket-lips were damaged beyond repair. Bed-rock, which in this locality is about 30 feet below surface, was not reached and the operation was suspended after about 25,000 cubic yards were dug. It was demonstrated that this type of dredge was totally unsuited to the conditions encountered. The gold-saving plant also proved unsatisfactory, and it is recorded that a test-slucing of tailings recovered more gold per cubic yard than was extracted by the plant. Three other companies also operated on Pine Creek during 1904 in the neighbourhood of Pine City.

The year 1906 ushered in a period of extensive large-scale mechanical operations, mainly hydraulicking, on Pine Creek. In this year the Atlin Consolidated Mining Company was organized by the Guggenheim interests and acquired property on the north side of Pine Creek, between "Discovery" and "Gold Run." A 70-ton Bucyrus tractor steam-shovel, with a 1¾-cubic-yard dipper and a capacity of 3,000 cubic yards per day, was installed. For gravel-haulage to an elevated screening and washing plant, a 5-ton electric locomotive, with 40 dump-cars, was used. To loosen the cemented gravel ahead of the shovel, blasting in "powder-drifts" was utilized. Hydraulicking with water pumped from Pine Creek by a 10-inch rotary electric pump driven by a 50-horse-power motor was also used. Electric power for this operation was supplied by the British-American Dredging Company's plant. At the close of the season a production of \$25,000 was credited to the shovel operation. The jointly-operated North Columbia Gold Mining Company and Pine Creek Power Company also produced \$70,000 in this season. During this year about 100 men, of whom about thirty were individual miners, were working on Pine Creek.

During 1907 the Atlin Consolidated Mining Company steam-shovel came into full operation and in 1908 is officially recorded to have "produced the largest output in the camp." Due, however, mainly to a "humpy" bed-rock and consequent drainage difficulty preventing a thorough working of the low and softer portions of bed-rock, operation was suspended at the close of the 1909 season. Following this, the Atlin Consolidated ground was hydraulicked by the North Columbia Company on a contract basis of the yardage moved. In 1907 the jointly-operated North Columbia and Pine Creek Power Companies commenced construction of a ditch to bring water from Surprise Lake to the south side of Pine Creek above "Discovery." This ditch, about 5 miles long, 26 feet wide at the top, and 6 feet deep, was calculated to carry 15,000 miners' inches on a grade of 8 feet to 1 mile. It was completed in the autumn of 1908 and was responsible for increased hydraulicking on Pine Creek in the following few years. Hydraulicking of the Atlin Consolidated ground was commenced in 1910, and from that year to the end of the 1913 season the North Columbia Company operated from six to fifteen 6- and 7-inch monitors each season, mainly on the north bank of the creek. It is apparent from a study of the ground and old records that drainage and tailing-disposal difficulty was experienced. At times three No. 6 Giants with 6- and 7-inch nozzles worked in each pit, with one Giant stacking tailings. An idea of the character of the work can be gathered from the operation in 1912 with twelve to fourteen monitors and a crew of fifty-five men. For the purpose of blasting clay and boulders a Sullivan air-compressor and three hand-stopping drills were used. About 50,000 square yards of ground were uncovered on the north side, 310,000 cubic yards of gravel were moved, and 16,525 square yards stripped. The average depth of the bank was 61.5 feet. An output of \$72,440.95 is recorded, and the gravel sluiced was estimated to carry 36.7 cents per cubic yard or \$2.35 per square yard of bed-rock.

In 1914 the old companies were reorganized into the Columbian Mining Company, which commenced operations in that year with a crew of fifty men and continued to 1917. Some criteria of the hydraulicking operations from 1910 to 1917 by the North Columbia and Columbian Companies are presented by the following tabulation:—

Year.	Cu. Yds.	Sq. Yds.	Total Bullion.	Value Cu. Yd.	Value Sq. Yd.	Average Depth.	Season Close.
				Cents.			
1910.....	159,610	44,305	\$71,751.22	45.0	\$1.62	10' 7"	Nov. 9
1911.....	176,090	32,360	65,652.59	37.5	2.21	18' 3"	Nov. 3
1912.....	197,600	30,805	72,440.95	36.7	2.35	19' 3"	Nov. 2
1913.....	181,100	23,235	81,148.82	44.8	3.49	23' 4"	Nov. 12
1914.....	167,500	18,140	53,319.06	31.9	2.90	27' 8"	Nov. 7
1915.....	168,900	15,425	64,213.95	38.0	4.16	32' 10"	?
1916.....	?	?	?	?	?	?	?
1917.....	?	?	41,000.00	?	?	?	?

In view of the discussion to follow under the head of "Geology," it is important to note that the 1915 and subsequent work was carried out on the north side of Pine Creek at the easterly extremity of the old hydraulic cut shown on the accompanying map and on the west boundary of the *Besbrook* lease. It will be observed that in this locality the pits were veering north with rim and bed rock sloping flatly north-westerly.

During this period individual mining on Pine Creek decreased and was confined to a few drifting operations, mainly under the north bank between the hydraulic cut and "Gold Run" and around the mouth of "Gold Run." Individuals are also reported to have made good recoveries from the sluicing of old hydraulic tailings. In 1909 and 1910 L. B. Harris prospected "Gold Run" with a Keystone drill, locating bed-rock at depths varying from 29 to 40 feet, but failing to find the "pay-streak."

Between 1911 and 1914 the Pine Creek Flume Company did some work with a donkey-engine and drag-line scraper at elevation 2,950 feet on the high bench about 1,000 feet north of the easterly end of the hydraulic cut. This company (C. L. Queen) also did extensive ditching and damming in an effort to bring water to their north-side operation from the small, shallow lakes on the high bench of the north bank and from Birch Creek.

In 1918 operations had dwindled to two groups of lay-men using five Giants, with a reported recovery of \$25,000, and some drifting. Work was also done by the Atlin Gold Mines Company, a new J. M. Ruffner organization, which acquired the Atlin Consolidated leases and plant. In this year the assets of the North Columbia, Pine Creek Power, Columbian Mines, and O'Donnel Placers Companies were acquired by F. H. Mobley, of Prince Rupert, who later conveyed a one-half interest to L. Schulz, of Atlin. A new organization called Discovery Mining and Power Company, Limited, was formed, and between this year and 1923 operations dwindled mainly to drifting by lay-men and some sluicing of old tailings. By 1924 activity on this once-famous creek had declined to one small hydraulic outfit and a few individual miners and Pine City ("Discovery") had become a "ghost camp."

In 1925 hopes were revived by the bonding of the Discovery Mining and Power Company's property by Charles V. Bob, of New York. In the hope of uncovering the down-stream continuation of Pine Creek old channel, and without any preliminary drilling or detailed geological investigation, these interests installed an elaborate plant and, starting at the lower end of the "Halfway" canyon, commenced an excavation in lacustrine gravel which is now locally known as the "Panama Canal." Using from two to three monitors, this operation continued to the end of the 1930 season, when it was suspended. The result was a cut about 3,750 feet long, 200 to 300 feet wide at its top, and varying in depth from 160 to about 20 feet between its lower and upper ends. About 2,750,000 cubic yards of gravel and sand were moved and only a very insignificant quantity of fine gold was recovered. In one or two places smooth, glaciated rim-rock was encountered sloping from 5 to 10 degrees southerly.

In 1932 Fred Helm and Company of five lay-men commenced hydraulicking on the south bank of Pine Creek ("Tar Flats"), about 1 mile below the mouth of "Gold Run." As is indicated on the accompanying map at the extreme easterly end of the old hydraulic cut on the south side of the creek, this work is very clearly on the left rim of Pine Creek old

channel with rim-rock dipping about 5 degrees northerly. A good recovery was made in this working during the two years of its operation. The north-easterly strike and northerly slope of the rim-rock gradually veered the succeeding pits towards the creek, and the floor rim-rock at the east end of the last pit excavated in 1933 is 5.5 feet below the water-level of Pine Creek, from which it is protected by a narrow bank-pillar. With a short stretch of workable rim-ground on the south bank still ahead of the last pit, the operation was forced to suspend on account of water-right complications.

In 1933 Keystone-drilling in 24 irregularly-spaced holes reported to average about 19 feet deep to bed-rock was done by Vancouver interests, starting 900 feet above "Stevendyke" bridge and continuing down-stream along the bed of Pine Creek for about 5,500 feet. In 1934 an hydraulicking operation was started on this ground by Northern Goldfields Exploration, Limited, composed of Toronto interests. To facilitate the operation the creek was turned into the "Panama Canal." Due to drainage difficulty and an insignificant recovery of only fine gold, the operation was suspended before the close of the season. In places where rock is uncovered by this work it is a characteristically hard, humpy, and smoothly-glaciated greenstone rim-rock, locally covered with blue glacial clay.

During 1934, 1935, and 1936 several individual miners have made fair recoveries from cleaning bed-rock in the old Columbian and Atlin Consolidated hydraulic pit. Drifting under the north bench in the upper section of this pit, towards the right rim of the old channel, has also returned fair recoveries. Drifting on the south side of Pine Creek in the locality of the mouth of "Gold Run" has also been continued by two individuals. In 1936 a small local syndicate commenced hydraulicking a strip of left rim-ground on the south bank of the old hydraulic cut opposite "Pine City" ("Discovery").

The bulk of the work on Pine Creek since 1898 has been confined to the central part of the valley in the neighbourhood of "Pine City" ("Discovery"). In this section the old hydraulic cut, 9,000 feet long, 500 to 1,125 feet wide, and from 25 to 60 feet deep to flat bed-rock, with its great piles of tailings, is an outstanding feature. Individual miners' old shovelling workings are seen in shallow rim-ground in the localities of "Stevendyke," "Pine City," and on the north side of the old hydraulic cut near Willow Creek, about 2,400 feet easterly of "Pine City." In the high rim-rock area westerly of "Pine City" and north of the road several cuts and trenches have been excavated through shallow glacial debris to rock. Exploratory shafts have been sunk on the north bench in several localities, but these are all filled with water. Judging from the dumps, these had been sunk mostly in blue glacial clay and had not reached bed-rock. One of these, known as the "Guggie" shaft, was sunk adjacent to the road on the north bank about 1,000 feet west of the east end of the old hydraulic cut. The depth of this shaft is not known, but it is reported to have encountered good values in "chicken-feed" creek-wash. It is estimated that at this point it is about 40 feet to the old channel bed-rock. Along the north side of the upper section of the old hydraulic cut the caved portals of several old adits and inclines are seen. On the north side of Pine Creek between the east end of the old hydraulic cut and the bridge are remains of apparently fairly extensive drift-workings under the north bench. These are caved or flooded, and it is understood, where bed-rock was reached, encouraging values were encountered, but drainage difficulties forced suspension of work. In the 1932 Annual Report of the Minister of Mines the probability of the old channel crossing to the north bank of Pine Creek above the bridge was suggested. Following this, a shaft was sunk 30 feet in glacial clay at elevation 3,004 feet by E. H. Woodean. This point is 72 feet above Pine Creek and is about 75 feet above the estimated position of the old-channel bed-rock. The shaft is being continued intermittently during the winter months.

During the 1936 season W. Kennedy was drifting up-stream under the north bench in an adit 1,950 feet west of the east end of the old hydraulic cut. In this working, flat, weathered bed-rock, humpy in places, with a gradient of about 1.2 per cent. is exposed, overlain with cemented creek-gravel. About 78 feet westerly of this working another adit driven by Kennedy for 261 feet along a bearing of north 10 degrees east shows flat weathered and humpy bed-rock to within 15 feet of the face, where the rim gradually rises to a height of 1.5 feet in the face. About 132 feet westerly of this an adit driven for 243 feet along a bearing of north 2 degrees west encounters rim-rock rising to 5½ feet in the face. About 2,000 feet east of Kennedy's adit, G. Borquist has sunk an incline sloping 24 degrees for

20 feet to bed-rock under the north bench and is drifting up-stream. These workings are located about 100 feet east of No. 1 post of the *Besbrook* lease and are badly flooded. Correlation of elevations on bed-rock between this point and the Helm hydraulic cut to the south-east shows bed-rock sloping 1 degree north-west. At Pine Creek it is 6 feet below the creek water-level and at the foot of the Borquist incline it is $7\frac{1}{2}$ feet below the creek.

Geology.—The part of the extensive alluvial fan extending up-stream from the mouth of Pine Creek to 6,100 feet east of "Halfway" was formed when Atlin Lake stood at a higher level. The superficial deposits of the fan area include lacustrine, aqueoglacial, and glacial deposits. In a few exposures along the "Panama Canal" the alluvial deposits rest on glacial drift, which in turn rests on smooth, glaciated bed-rock. Glacial drift and inter-Glacial wash is also seen resting on bed-rock at the foot of the "Halfway" canyon at 2,414 feet elevation, and in places on high rim-rock at 2,600 feet elevation just east of "Halfway." Two instances of small lengths of decomposed clayey rock flanked and overlain by glacial debris and lying on smooth glaciated bed-rock were observed at widely separated points along the bottom of the "Panama Canal." In one such instance at the foot of "Halfway" canyon a small patch of decomposed rock 4 feet thick, lying on glaciated greenstone, is overlain by 4 feet of typical old-channel gravel, which in turn is overlain by glacial drift. On both sides of this, glacial drift rests on bed-rock. These weathered masses are evidently erratics.

"Halfway" canyon is a narrow, rugged, and vertical-sided incision in rock with poholed floor, in places obstructed by large, jagged slide-rock blocks. Its vertical, rugged sides and freedom from any sign of glacial action clearly show that it is post-Glacial in age. From the head of the canyon to its foot there is a fall of 138 feet in a length of 1,500 feet. Since Pine Creek is now by-passed through the "Panama" canal the canyon can readily be examined. The bed-rock of Pine Creek at the head of "Halfway" canyon is 86 feet above the bottom of the "Panama" canal. At this point exposures of rim-rock in the floor of the cut are overlain by glacial drift and slope from 10 to 20 degrees south-easterly. In the floor of the cut about 450 feet from its easterly end an exposure of fresh rim-rock overlain by glacial drift also slopes 10 degrees south-easterly. The exposures and general aspects in this locality indicate that Pine Creek in this section occupies a post-Glacial channel and that the floor of the trough is situated a short distance south of the "Panama" canal and at a lower elevation than the bottom of the cut. Projecting Pine Creek pre-Glacial bed-rock from elevation 2,819 feet, opposite "Pine City" for a distance of 1,050 feet westerly, with an assumed average bed-rock grade of 1.3 per cent. as indicated in the old "Discovery" hydraulic cut, would place the old-channel bed-rock at elevation $2,682\frac{1}{2}$ feet at a point slightly south of the central section of the "Panama" canal. In other words, this projection would place Pine Creek pre-Glacial channel about $82\frac{1}{2}$ feet above the top of the "Panama" canal. For the projected old channel to coincide with elevation 2,466 feet at the bottom of the central section of the "Panama" canal would require an average gradient of 3.3 per cent. from elevation 2,819 feet in the old cut at "Pine City." Rim-rock exposures in the "Panama" canal cut, as already cited, indicate the floor of the trough in this locality to be at an even lower elevation than the bottom of the cut, requiring a gradient in excess of 3.3 per cent. for coincidence with the projected pre-Glacial channel.

In former years it had been locally supposed that the old channel of Pine Creek had veered southerly from "Discovery" and flowed through and across "Stevendyke" at about its westerly end. The alignment of high rim-rock and correlation of levels in this section do not support this theory. The continuation of high rim confines the pre-Glacial channel on this side. Theories have also been advanced that the old channel continued from the old hydraulic cut under the north bench below "Pine City" and flowed north-westerly through Trond Gulch. Obstructing high rim-rock and correlation of levels prohibit this possibility.

Alignment of rim-rock along the southerly side of the easterly end of the old hydraulic cut, especially in the locality of the Helm workings at the extreme east end of the cut, clearly confines the old channel on this side. At the east end of the Helm workings the south rim leads into Pine Creek and strikes north-easterly across the creek, placing the north-easterly continuation of the south rim of Pine Creek pre-Glacial channel under the moraine bench of the north bank of the present creek-site. Above the Helm workings Pine Creek has incised its new channel from 6 to 20 feet into high rim-rock, which continues along the south bank for about 400 feet easterly of the Helm hydraulic pit. From this point for a distance of 700

feet up-stream to the bridge is a gap in rim-rock outcrop. At the bridge high rim-rock again outcrops along both the north and south banks of Pine Creek. At the edge of a rim-outcrop on the north bank of the creek about 200 feet above the bridge, an old caved adit under the bench, which at this point is 25 feet high, is reported to have been driven 150 feet. The face of the adit is reported to be wholly in the high rim. About 900 feet easterly of this point, another caved adit is reported to have been driven 200 feet under the bench, with rim-rock rising to a height of 4 feet in the face. At this point the bench is 40 feet above Pine Creek. These points line up with the strike of the south high-rim ridge confining the old channel along the easterly end of the old hydraulic cut. Above this point rim-rock outcrops for frequent and continuous stretches along Pine Creek and the contiguous road for a distance of about 8,250 feet above the bridge. The present channel of Pine Creek is incised from 5 to 15 feet deep in these rock-exposures. The vertical and rough sides of the confining rock banks clearly indicate this channel to be post-Glacial in age.

The area of the north bench, under which the north-easterly continuation of Pine Creek pre-Glacial channel projects, is continuously covered with morainal and aqueoglacial deposits, from about 40 to 75 feet above the elevation of Pine Creek. Along the north bank of Pine Creek, and commencing about 360 feet up-stream from the upper caved adit, a flat bench from 10 to 20 feet above the creek and 1,200 to about 2,250 feet wide ("Birch Creek flats") borders the high bench. This probably represents the post-Glacial erosion of Pine Creek preliminary to its confinement in its present channel. Towards Birch Creek the high bench gradually lowers in elevation to merge with "Birch Creek flats." Where the high bench has sloughed it is seen to be composed of glacial clay and drift, with small local areas of weakly-imbriated aqueoglacial gravel. At one place, about 1,500 feet up-stream from the bridge, an isolated patch of the typical yellow, pre-Glacial creek-gravel of the area occurs isolated in the glacial deposits of the north bank high bench. This is evidently the result of transportation and redeposition.

The gap of 700 feet in the south rim of Pine Creek pre-Glacial channel below Pine Creek, already referred to, marks the junction area of the old "Gold Run" channel with the old channel of Pine Creek. As would be expected with such a condition, high values are reported to have been encountered at this point by drifting at the mouth of the "Gold Run" channel and by shovelling from the bed of Pine Creek below the mouth of "Gold Run." In the old drift-workings at the mouth, bed-rock of the old "Gold Run" channel at this point is about 10 feet below the water-level of Pine Creek. Several shafts have been sunk and some drifting done in intermittent sections along a stretch of about 4,500 feet of the "Gold Run" channel. These old workings are either caved or flooded, but bed-rock or rim is reported to have been encountered at depths varying from 12 to 40 feet. In H. Woodean's shaft-workings, about 650 feet west of the old dredge, bed-rock is encountered at a depth of 30 feet. A winding channel about 20 feet wide between rims and with a bed-rock gradient of about 1.5 per cent. is indicated in the drifting and crosscutting. This is overlain by from 4 to 8 feet of cemented gravel, with moderate distribution of boulders up to an average maximum of about 24 inches in diameter. Larger boulders are sometimes encountered. Bed-rock is generally decomposed and clayey for a depth of about 18 inches, but varies in hardness and composition and is characteristically "humpy." Water is pumped by a Cornish pump and values are reported to average about 0.06 oz. gold per cubic yard of bed-rock gravel. The north high rim of "Gold Run" old channel exposed along the road is the south high rim of the projected pre-Glacial channel of Pine Creek in this locality.

Pine Creek pre-Glacial channel is well exposed in the old hydraulic cut opposite and above "Pine City." Bed-rock is of varying composition and consists mainly of serpentine, magnesian rocks, limestone, cherty slate, and quartzite intruded locally by granitic dykes. Of these, serpentine, magnesian rocks, and slate have the widest distribution. Bed-rock is generally appreciably weathered to a soft clayey material, especially in the sections of serpentine and magnesian rocks, but hard, "humpy" sections also occur. The gradient is not constant, but averages about 1.3 per cent. The best values occur on and in bed-rock. Values recovered in large-scale operations are cited in the section of this report dealing with history. This is indicated as only partial recovery, and good recoveries have and are being made by individuals resluicing tailings and shovelling worked bed-rock, especially in low soft sections. Relative to this phase of the old operations, it is interesting to note that a nugget weighing 49 oz. was picked up in 1925 on one of the old hydraulic tailings-dumps.

The old channel bed-rock is overlain by from 10 to 20 feet of cemented creek-gravel. In this boulders are not abundant and range to a maximum average of about 30 inches in diameter. In the old hydraulic cut a channel-width of about 1,000 feet between rims is indicated. The cemented creek-gravel is overlain by 15 to 30 feet of blue glacial clay and drift in which is locally included some aqueoglacial wash-gravel and sand. In W. Kennedy's adit-workings, already referred to, under the north bench, 1,950 feet westerly from the extreme easterly end of the old hydraulic workings, the operator reports recoveries varying from 2 to 3 oz. gold from 40 square feet of bed-rock. It is significant that these workings are on the north rim-side of the channel at the commencement of the projection of the old channel continuation under the north bench of Pine Creek.

About 1,400 feet westerly of Kennedy's workings, near the mouth of Willow Creek, Geasen and Hoffman are shovelling-in soft bed-rock from a low area in the old hydraulic workings along the north rim and report good recoveries. About 50 feet west of this place the north rim rises steeply to a rock bench 15 feet high and from its crest slopes 15 degrees north under the road. Several cuts through this rim have been made by "old-timers" in the attempt to strike bed-rock to the north. In every instance where it has been crosscut the rim continues with a northerly dip. Tracing this rim westerly for 2,250 feet to the clay bluff, 300 feet easterly from "Pine City," it is seen to retain its northerly dip in several exposures. In the face of the bluff it is overlain by glacial clay at 20 feet above the level of Pine Creek. An incline, now caved, has been sunk on the rim at this point. These exposures indicate in this section a possible channel lateral to and north of the known old channel of Pine Creek.

Cross-sectional traverses of Pine Creek Valley failed to establish the existence or preservation of any high-bench pre-Glacial channel. At elevations 3,000 and 3,200 feet, along the foot of Munro Mountain, remnants of two rock benches were observed. These show evidence of glaciation and several lakes and swamps now occupy shallow depressions along them.

Conclusion.—(1.) The location of Pine Creek pre-Glacial channel is indicated along the course shown on the accompanying map.

(2.) It is indicated that Pine Creek pre-Glacial channel does not contain auriferous deposits in its westerly section commencing somewhere between "Pine City" and the "Panama Canal."

(3.) Pine Creek pre-Glacial channel is indicated to continue under the north bench of Pine Creek, striking in a general direction of north 56 degrees east from the easterly termination of the old hydraulic workings and towards Birch Creek Flats. Along this projection the old-channel bed-rock is indicated to lie at from about 40 to 90 feet below the surface.

(4.) The length of sectional lengths of pre-Glacial channel that have not been affected by glaciation along the projection of this north-easterly extension to Surprise Lake are unknown. This factor requires determination by drilling or other exploratory methods.

(5.) The old channel is known to be gold-bearing at the termination of the most easterly workings on it. The continuation and extent of gold content along its north-easterly projection are unknown and require determination by drilling or other exploration methods.

(6.) A flat and uneven old-channel bed-rock gradient is indicated. Details of this factor, together with the character of bed-rock and the overlying superficial deposits along the projected extension, will determine the method to be employed in any possible operation and will have to be ascertained by drilling or other exploration methods.

(7.) Local remnants of likely south rim-ground still remain in the central section of the old hydraulic cut.

(8.) Gold values are indicated as still remaining in sections of partially-worked bed-rock and also in the now weathered and slacked clayey tailings-dumps in the old hydraulic workings.

(9.) The present bed of Pine Creek in the old hydraulic cut along a stretch of about 8,500 feet is indicated as likely shallow ground. To make it accessible for investigation the creek can be readily turned from its present course at several places.

(10.) A lateral channel adjacent to and north of the known Pine Creek pre-Glacial channel is indicated. Verification of this and details of possible values, depth, etc., require determination by drilling or other exploratory methods.

SPRUCE CREEK.

Spruce Creek flows north-westerly into Pine Creek about 2½ miles from its mouth. It occupies a drift-filled valley about 15 miles long between elevations of 2,300 feet at its mouth and 4,000 feet at its head. It is reached by the Atlin-Surprise Lake Motor-road to "Pine City," from where a branch road extends for 4½ miles up the valley to the Colpe Mining Company workings. Another branch road follows along the high bench of the north side to Rose Creek, about 1¾ miles from the headwaters.

Towards its mouth the valley merges into the wide fan area of the lower section of Pine Creek Valley. Above this the valley is confined on the north by Bald Mountain and its easterly extension and on the south by the Monarch Mountain range. Between the steep slopes of these mountains the valley-floor in its central section is from 1½ to 2 miles wide and deeply filled with glacial drift. Above this towards "Blue Canyon" and the headwaters in the divide to the O'Donnel River at elevation 4,000 feet the valley flattens to a wide gently-sloping, moraine-covered area through which a few rocky ridges and knolls outcrop. The present channel of Spruce Creek is incised in the moraine deposits of the valley-floor which form hummocky benches from 70 to about 350 feet high bordering the creek on both sides. The main tributaries are Little Spruce Creek and Dominion Creek, flowing into Spruce Creek from its south side.

The creek occupies a moderately-winding channel from 20 to 30 feet wide in a trough 150 to 400 feet wide, and with the exception of five small rock canyons is confined along its entire length by moraine benches. Along its length the creek-gradient varies slightly, the steepest parts being in the rock canyons. In the lower section for 2.8 miles in the valley-fan area to the foot of the first canyon the gradient averages 2.7 per cent. For the next 3.3 miles up-stream to the foot of the second canyon at the Colpe Mining Company's workings the gradient averages 2.1 per cent. Up-stream from this point for 1.5 miles, including the second and third canyons to the foot of "Dry Canyon," the gradient steepens to an average of 4.8 per cent. From this point up-stream for 3.5 miles to the "Blue Canyon" area the creek-gradient gradually flattens to an average of 1.5 per cent. For the next 1.5 miles up-stream, through "Blue Canyon" to the locality of Rose Creek, the canyon is responsible for a slight increase of gradient to an average of 1.7 per cent. From this point for 2 miles to the headwaters in the O'Donnel River divide area the gradient flattens perceptibly to an average of 1.2 per cent. In the headwaters section the trough is flat and marshy with a gradient of less than 1 per cent. and gradually merges into the south-easterly slopes to the O'Donnel River drainage-trough.

Geology.—With the exception of the canyon sections and the headwaters area, rock-outcrops through the moraine deposits of the valley-floor are scarce and of small extent. Correlating these with exposures of the confining mountains and with bed-rock in the workings indicates the basal formation of the lower 9 miles of Spruce Creek, from about Rant Creek to the mouth, to consist of pyroxenite, serpentine, greenstone, and magnesian rocks of the "Gold series." Of these, greenstone, serpentine, and magnesian rocks have the greatest distribution. Up-stream from Rant Creek to and beyond the headwaters the formation consists of grey and black slates, cherty quartzites, and some limestone. Of these, the slate components appear to have the widest distribution.

During Tertiary time the valley of Spruce Creek was further eroded and a deeper channel incised in its former more mature valley. The valley was filled with glacial drift, in which the stream has cut a new channel, leaving the old channel, with its flatter gradient, deeply buried. A length of 16,500 feet of pre-Glacial channel is known to be preserved and richly gold-bearing, generally deeply buried by glacial drift. This has been extensively worked and mining is still continuing at many places along it and is proceeding up-stream along its established course in ground carrying good gold values. In former years, for some unknown reason, it had been assumed the old channel continued up-stream under the north bench north of the third canyon. In Bulletin No. 1, 1931, "Placer-mining in British Columbia," it was pointed out that the pre-Glacial channel crossed Spruce Creek between the high rock-rims of the second and third canyons and continued up Lower Dominion Creek trough. Subsequent mining has verified this and field-work during the 1936 season indicates a further stretch of at least 5 miles of favourable ground along the projected course under the south bench of Spruce Creek. Where it has been worked, weathered bed-rock of the old channel is overlain

by from 6 to 10 feet of clay-cemented creek gravel, with boulders up to a maximum average of about 30 inches. Gold values vary from about $\frac{1}{2}$ oz. to about 20 oz. per 40 square feet of bed-rock (one "set"). The grade of the old channel varies slightly, is locally "humpy," but averages about 1.8 per cent. in its worked section. In the upper stretch of 2,700 feet of this section the grade tends to steepen and is 2.2 per cent. The width of the old channel between rims varies from 600 to 1,200 feet in the lower section to about 375 feet in the upper section of its worked length. In places, especially in the wide section, there are two or more lateral and branching channels separated by a low rim of gently-sloping bed-rock. It is possible that the exceptionally rich ground of the most recently-worked up-stream section can be attributed to the narrowing of the channel in this direction.

Adjacent to the south rim of the old channel in the region of the first canyon a lateral and deeper channel is indicated. It is possible this may extend north-westerly beyond the extremity of the main channel, at sufficient depth to have been unaffected by glaciation.

In the 2.8 miles of the lower section of Spruce Creek, from its mouth to the first canyon, and embraced by the valley-fan within the boundary of the post-Glacial lake-level at elevation 2,660 feet, glaciation has been acute. Spruce Creek pre-Glacial channel bed-rock at elevation 2,732 feet is truncated and left hanging 22 feet above the water-level of Spruce Creek. This is at the lower end of the first canyon into the valley-fan area. At the portals of the drift-workings, heading south-easterly on the old channel at this point under the moraine bench, blue glacial clay rests on fresh bed-rock for a distance of about 100 feet along the old-channel course. Old-channel cemented gravel then begins to appear intermittently on weathered bed-rock until it reaches a thickness of 6 to 7 feet between bed-rock and glacial clay. About 1,100 feet down-stream from the first canyon a glaciated rock-exposure on the right bank of Spruce Creek at elevation 2,680 feet is overlain by blue glacial clay. Projecting Spruce Creek pre-Glacial channel bed-rock for 7,200 feet north-westerly from the first canyon, with an average grade of 2 per cent., places it at elevation 2,588 feet in the region of the upper section of the "Panama Canal." This is 49 feet above glaciated rock exposed at the bottom of the "Panama Canal" at this point. A projection for 8,100 feet north-easterly to the road 1,000 feet east of "Halfway" places Spruce Creek old channel at this point 20 feet below the level of the obstructing high rim-rock at "Halfway." This obstructs the possible continuation of the Spruce Creek pre-Glacial channel beyond "Halfway" towards Trond Gulch.

Gold was recovered by individual miners from shallow diggings on rim-rock along Spruce Creek, below the locality of the described pre-Glacial channel truncation. This can be attributed partly to transportation by Spruce Creek whilst cutting across the old-channel site and partly to reconcentration of gold scattered in the moraine by the creek cutting down to its present channel.

History.—Gold was first discovered on Spruce Creek in the locality of Eureka Creek in 1898. The early operations by individuals did not disclose particularly encouraging results. The ground was found to be deep; the small claims allowed at that time did not permit dump-space or drainage. In 1901 there were about 100 men on the creek and hydraulicking companies began to be interested. It was soon apparent, however, that water and dump requirements of hydraulicking operations conflicted with the individual miners who were working the comparatively shallow creek-ground in the locality of the first canyon. A limited amount of hydraulicking was carried out in the neighbourhood of the first canyon, at the east end of the second canyon, around the southerly end of the third canyon, and in the locality of Blue Canyon. In 1904, associates of the British-American Dredging Company incorporated the British Columbia Dredging Company and without preliminary exploration, excepting that in individual miners' workings, commenced installation of a dredge in the Blue Canyon area. Electric power for this was drawn from the British-American Dredging Company's plant on Pine Creek. The dredge was a Bucyrus open-connected type with $7\frac{1}{2}$ -cubic-foot buckets. Construction was completed in 1905 and after digging for a few weeks in 1906 the type of dredge proved unsuitable and operation was suspended. About 1905, Northern Mines, Limited, installed a steam-shovel in the creek-ground of the lower section. Good recoveries were being made all around the shovel by individual miners, but drainage difficulties and the depth of ground encountered caused suspension of the shovel operation about 1907.

Large-scale drifting under the south bench at the first canyon was carried out by the Spruce Creek Power Company (W. C. Hall and A. D. Hughes) between 1909 and 1916. During the same period extensive drifting was also carried out by McCloskey and Foley under the south bench on the *Gladstone* lease about 3,000 feet south-easterly from the first canyon. Contemporaneous with this, the south-bench ground north of the *Gladstone* to as far as Eureka Creek, including the *Peterboro*, *Poker*, *Joker*, and *Crocker* bench leases, was opened by inclines to the old-channel bed-rock and continuous drifting with good recoveries carried on. During this period Spruce Creek became the most active and productive creek in the Atlin area, a position which it has retained.

In 1915 J. M. Ruffner commenced sinking a shaft on the north bank of Spruce Creek, opposite Eureka Creek, to explore for the continuation of the channel under the north bench in this locality. Drainage difficulty at first hampered operations in this section. With the establishment of drainage-adits, however, deep-drifting on the old-channel bed-rock has steadily progressed up-stream. In Bulletin No. 1, 1931, "Placer-mining in British Columbia," issued by the British Columbia Department of Mines, the continuation of the old channel south-easterly across Spruce Creek, between the second and third canyons, and up the lower section of Dominion Creek trough, was described. By the end of the 1936 season this had been verified by drifting to about the point where Spruce Creek crosses the channel-projection, in ground returning from 2 to 12 oz. gold to the "set" (40 square feet) and averaging from 4 to 5 oz. to the "set." Field-work during 1936 established the continuation of the old channel under the south bench for an appreciable distance beyond this point.

A remarkable feature of Spruce Creek is the fact that, despite the extensive drifting operations of early years under the south bench between Eureka Creek and the first canyon, mining has been continuously carried on in this section by individuals, both under the bench and in the creek-ground. In the lower section much of this drifting-work has required penetration of caved workings to reach pillars, or marginal ground lateral to or beyond the old workings. In general, fair recoveries have been made from this work. Of interest in this connection is the good recovery made by Carl Lykergard between 1933 and 1936 in drifting around the extreme southerly limits of the old McCloskey workings on the *Gladstone* bench lease, in a section about 900 feet under the bench from Spruce Creek. In 1936 a nugget weighing 44 oz. 3 dwt. was found by Lykergard in this locality. Unfortunately, no methodical surveying of the workings was done during the early operations and there are no maps, records, or plans of them. Their scope and extent is consequently not known and operations in and about them is necessarily haphazard or based on hearsay. Despite this, in some instances good recoveries have been made in and about old workings and generally the continued work has returned wages or better. Examinations by the writer of the accessible old workings indicates that these were generally carried along narrow margins of "pay." In many instances where flat, weathered bed-rock is continuous beyond these margins there has been no attempt at lateral exploration by crosscutting or continued drifting. In some instances the old workings are in a badly-caved condition; in others, possibly flooded through blocking of drainage-adits. The reopening of these is costly and hazardous and on account of the lack of survey-plans it is impossible to select points for new entries and workings that would be definitely known to circumvent the old workings.

In the section between the first canyon and Eureka Creek the old channel is wide and its southerly boundary indicated by the known limits of old workings and approximate correlation of rims at Eureka Creek and the first-canyon section. A remarkable feature in all the most southerly workings examined in this section is the absence of any high rim confining the channel on the south. In some places a low rim, rising to 2 or 3 feet above flat bed-rock, is seen and in three localities a slight dip to the south of weathered bed-rock occurs. In the steam-shovel cut south-easterly of the first canyon a low south rim of the main channel strikes south-easterly and at its crest slopes south-westerly. This is correlated with a similar low rim in the old drift-workings under the first-canyon bench and in a deep channel indicated by shafts to the north-west of these. These factors indicate a possible channel lateral to and south-westerly of the known old channel.

The shallow creek-ground, commencing up-stream from the first canyon at the point where the old channel emerges from under the high bench west of the canyon, has been worked and reworked continuously since the early days by shovelling, hydraulicking, and steam-shovelling

for a distance of about 6,750 feet up-stream. In the upper section of this stretch along the north rim of the channel on the *Olalla* and *Tax* leases, the Columbia Development Company has been operating a steam-shovel continuously since 1934 on both virgin and formerly-worked ground. In 1936 the same company successfully operated a second shovel in the lower section on the *Lynx* lease. Up-stream from the *Olalla*, on the *Rose*, *Hope*, *Shamrock*, *Sally*, *Friendly*, and *Maska* creek claims, on the *Cassidy* group above these, and about 600 feet west of Eureka Creek, the creek-ground is largely virgin. In the lower section some drifting has been done, but drainage difficulty is experienced. In the upper stretch, including the *Sally*, *Friendly*, *Maska*, and *Cassidy* groups, test-shafts have been flooded. Depth to the old-channel bed-rock along this stretch of Spruce Creek varies from about 22 feet in the lower section of the *Olalla* lease to an estimated depth of 45 feet in the locality of Eureka Creek.

A characteristic of the Spruce Creek old-channel gravel is the tenacious yellow clay cementing it. This characteristic permits only partial recovery on first sluicing and sometimes is even the cause of sluice-box "robbing." After tailings-dumps have been exposed to weathering for some time the clayey material slacks and disintegrates and the resluicing of this material returns an additional recovery. For this reason old tailings-dumps on Spruce Creek are being continuously reworked and good recoveries have been made from them, sometimes after several such handlings.

Locally, wide streaks of clean "blue" gravel occur along comparatively clean-cut lines either in or overlying the "yellow" gravel. Frequently, these stretches of "blue" gravel or their lower contacts with the "yellow" gravel have returned exceptionally good values. This condition has given rise to a miners' theory of a later and richer "run of gravel," called the "blue run." In all such occurrences examined by the writer no evidence to suggest a second "gravel run" was observed. In some such occurrences, however, the ground was seen to be very wet, the gravel loose and washed comparatively free from ferruginous clay. In these cases the rich "blue run" could be explained by the washing of the "yellow" gravel by running springs or freshets accompanied by a reconcentration of gold on the underlying clayey "yellow" gravel. In other cases where a "blue" clayey gravel was observed the condition can be ascribed to a periodical variance in fine sediment carried by the original stream.

Lassie Creek Lease. This lease (P.M.L. 750) is owned by J. Pirnie, of Atlin, and is located about 1,500 feet westerly of the first canyon. On the north bank of Spruce Creek blue glacial clay occurs on glaciated bed-rock. In the creek-trough, 140 feet, south 59 degrees west from this point, the owner has sunk a shaft in creek-gravel and glacial clay for 10 feet. From the bottom of the shaft a pipe-drill has been driven an additional 36 feet in glacial clay. About 300 feet southerly from the shaft, fine post-Glacial gravel-wash rests on rim-rock sloping 12 degrees north-easterly towards the creek. Fine gold is being recovered from the sluicing of this material.

St. Quentin Lease. This ground is located on the high bench covering the old-channel location west of the first canyon. It adjoins the *Key* and *Lynx* leases on the north-west and the *Jewel* lease on the south-west. The ground was formerly extensively drifted by the Spruce Creek Power Company. W. Faulkner is continuing drifting and crosscutting around the south-easterly margin of the old workings and recovering from 70 cents to \$1.50 per cubic yard of gravel sluiced.

Jewel Lease. This lease is owned by Teresa Beaton, Atlin, and is being worked on a "lay" by W. Carl Horn and Ole Hultgren. The ground is located west of the first canyon adjoining the *St. Quentin* on the north-east and covers the easterly side of the old channel under the high bench. The ground was formerly extensively drifted. The present operators are working around the south-easterly limit of the old workings into virgin ground to the south-east and report an encouraging gold-recovery.

Lynx Lease. This ground is situated south of the easterly end of the first canyon and adjoins the *St. Quentin* on the south-east. The lease was taken over on a "lay" by the Columbia Development Company (A. R. Kaufman and associates, of Kitchener, Ontario), which installed a steam-shovel and mobile sluicing plant designed by D. Eastman. The shovel is equipped with a ½-cubic-yard dipper and the sluicing plant with a trestle incline and a 1½-cubic-yard-capacity dump-skip operated by a 15-horse-power LeRoy single-drum gasoline-hoist. Gasoline-consumption is 4 to 5 gallons per shift and wood-consumption for the shovel-boiler is about three-quarters of a cord per shift. An

average crew of nineteen is employed. At the time of examination the shovel was digging in a "gut" about 15 feet deep along the south rim of the old channel. The gravel sluiced is estimated to carry about 0.0322 oz. gold per cubic yard.

Hardscrabble Lease.

This lease is located about 825 feet south-easterly from the *Lynx* lease, adjoins the *Baldwin* lease on the west, and is owned by J. Clay of Atlin. The creek-ground in this locality is about 12 feet deep to bed-rock and had been continuously worked by the owner up to 1936. For this operation the creek was turned and gravel from the pit was shovelled into skips hoisted by a water-wheel and high-line equipment. Drainage of the pit was assisted by a Chinese pump. Spring floods destroyed the pit and equipment. Near the south-east corner and adjacent to the *Pillar Fraction* two individuals are drifting and crosscutting under the south bench, adjacent to the *Gladstone* lease.

Gladstone Lease. This lease covers the location of the old channel under the high south bench about 2,700 feet south-easterly from the first canyon. At this point Spruce Creek crosses the site of the old channel diagonally from east to west. The ground is owned by Jack Tintinger, of Atlin, and was formerly extensively drifted by McCloskey and Foley. During the last three years Carl Lyktergaard, working on a "lay" from Tintinger, has penetrated a portion of the old workings from an incline shaft in the easterly half of the lease and carried out drifting in virgin ground on flat bed-rock along the southerly margin of the old workings about 900 feet into the bench. Good recoveries were made from this work up to the spring of 1936, when values began to diminish. Rather than risk his profits in further prospecting, the operator completed the sluicing of his tailings and relinquished the "lay." Of interest is the recovery of a nugget weighing 44 oz. 3 dwt. during the last period of drifting.

Peterboro Lease. This ground covers the location of the old channel under the high south bench, adjoining the *Gladstone* lease on the east. It has been extensively drifted at various times since the early days. At present Otto Miller is drifting southerly from a shaft inclined 20 degrees for 54 feet. His workings have penetrated and skirted old workings and have advanced into virgin ground with flat bed-rock about 600 feet into the bench.

Tax and Olalla Leases.

These creek leases cover the north side of the old-channel ground adjacent to and north of the *Gladstone* and *Peterboro* bench leases and the south-easterly continuation adjacent to and north of the *Poker* bench lease. In former workings the *Tax* lease had been worked by hand-shovelling to bed-rock, with the exception of a strip 150 feet wide and 600 feet long in the central section. The *Olalla* lease, adjoining the *Tax* on its up-stream side, appears to be unworked ground. In 1933 the ground of both leases was drilled by A. R. Kaufman, of Kitchener, Ontario. In 1934 the Columbia Development Company, controlled by these interests, installed a Bucyrus-Erie caterpillar steam-shovel with a mobile sluicing plant designed by D. Eastman and J. Walsh. The shovel is equipped with a $\frac{7}{10}$ -cubic-yard-capacity dipper. A double-track incline extends from the washing plant to the pit and skips of $\frac{7}{10}$ -cubic-yard capacity are hoisted by a 35-horse-power double-drum gasoline-hoist, consuming 7 to 8 gallons per shift. Wood-consumption for the shovel-boiler is about 1 cord per shift. An average crew of about twenty-two is employed.

The operation has required the carrying of a drainage-cut from the down-stream end of the *Tax* lease and digging through the previously-worked sections of this ground. It is interesting to note that recoveries from this work have been satisfactory. By the end of July, 1936, the shovel had advanced to about 150 feet from the *Olalla* line. In this section the bed-rock is humpy, with a cut 32 feet deep to bed-rock along the north rim, bordered on the south by a hump about 20 feet high. The gravel sluiced is estimated to carry 0.0237 oz. gold per cubic yard.

Hope Fraction. This creek claim, located about 400 feet up-stream from the easterly boundary of the *Olalla* lease, is owned by L. Schulz, of Atlin, and is being worked by Axel Nelson on a "lay." A shaft is sunk 35 feet to bed-rock to connect with a bed-rock drain, preparatory to drifting on bed-rock under the creek. Previous work by the same operator in this ground showed good bed-rock values, but the ground proved excessively wet for drifting.

This bench lease is owned by I. Matthews and covers the location of the old channel under the high south bench adjoining the *Olalla* creek lease on the south. Appreciable drifting has been carried out on this ground at various times. Drifting in recent years by I. Matthews has advanced about 500 feet into the hill on flat decomposed bed-rock, at which point bed-rock dipped southerly into the hill, indicating the possibility of a deeper channel lying southerly of the old channel now being worked. Bed-rock ground in these workings returns from about \$1.50 to over \$2.50 per cubic yard.

During 1936 John Huget and four partners were working on a "lay" from I. Matthews. Drifts from a 108-foot shaft inclined at 15 degrees extend 270 feet south-westerly into the hill, skirting old workings lying to the east. At the time of examination on July 9th an average of forty cars ($\frac{1}{2}$ yard) per day were being sluiced, averaging about \$2 per car. A clean-up on July 9th returned 32 oz. gold from 250 cars, an estimated equivalent of about 2.5 oz. per "set" (40 square feet).

These bench leases adjoin the *Poker* on the south-east and are owned by **Joker and Croker Leases.** I. Matthews, of Atlin. The ground covers the location of the old channel under the south high bench up to the *Ajax* lease in the locality of Eureka Creek, where the old channel crosses Spruce Creek to the north bench. Appreciable drifting by the owner and "lay-men" has been carried on in this ground at various times, but an appreciable extent of favourable virgin ground still remains on these leases.

In the easterly half of the *Croker*, adjoining the *Joker* on the south-east, two main drifts, from vertical shafts 20 feet above the creek and 60 feet deep to bed-rock, extend respectively 450 and 510 feet southerly under the bench. The ground is being worked on a "lay" by Fred Oman and partners. In the present most southerly workings the ground is reported to average about 2 oz. to the "set."

This partnership is drifting in the old channel under Spruce Creek on the **Bratt, Morse & Co.** *Jimmy Hill* and *Edith Hill* claims, about 600 feet north-easterly from Eureka Creek. In this section the old channel narrows perceptibly to a width of about 325 feet between high rims. The best ground is about 30 feet wide along the centre line of the channel, the bottom of which is about 100 to 150 feet wide. Drifting is carried out from a shaft 73 feet deep to bed-rock, and has been extended about 800 feet up-stream to about 70 feet west of the *Chance* creek lease. The last 450 feet is reported to have returned an average of 10 oz. gold to the "set" (40 square feet) across a width of 30 feet. In places 20 oz. to the "set" is reported to have been recovered. Appreciable favourable ground still remains between the shaft and the easterly extremity of drifting, lateral to the present workings. The ground is drained by a bed-rock adit but is wet. At the close of the 1936 season this ground was taken over by the Colpe Mining Company, Limited, which is working the ground adjoining on the east.

This bench lease, adjoining the Bratt-Morse ground on the south, covers the **Wolf Lease.** south rim of the old channel and is being worked by Eric Backsten and partners on a "lay" at 300 feet south 75 degrees east from the Morse shaft. A shaft inclined at 60 to 79 degrees encounters gently-sloping rim-rock at a depth of 60 feet. A southerly drift for 135 feet encountered a rising high rim, striking south-easterly. Two short drifts easterly, at 54 feet from the shaft and parallel with the *Wolf* north boundary, showed a flatter rim condition. The best returns will be obtained by drifting easterly as close to the *Wolf* north boundary as possible.

This bench lease adjoins the Morse creek-ground and the *Chance* creek claim **Clydesdale Lease.** on the north. It adjoins the *Dorothy* bench lease on the east and the *Goodwill* bench lease on the west. The southerly section of the *Clydesdale* covers the north rim of the old channel, which strikes diagonally across the lease from about the south-west corner to about 360 feet northerly of the south-east corner. The ground is being worked by W. Buchanan from a vertical shaft 82 feet deep to bed-rock, located about 800 feet south-easterly of the Morse shaft. A crosscut to north-west encountered high rim about 160 feet from the shaft. Drifting up-stream, south-easterly, shows rim sloping about 5 degrees south-westerly towards the creek. Irregular values have been recovered along the rim-slope. As work proceeds up-stream towards the east boundary a greater width of the channel flat bed-rock should enter the property.

**Colpe Mining
Co., Ltd.**

This is a private company incorporated in British Columbia in May, 1935, with a capitalization of \$50,000. The registered office is at 800 Hall Building, Vancouver. The holdings embrace the *Chance* creek lease, adjoining the Morse-Bratt ground on the east; the *Goodwill* bench lease adjoining the *Clydesdale* bench lease on the east; and the *Sunlight* creek claim, adjoining the *Goodwill* on the east. At the close of 1936 the company also acquired the Morse-Bratt creek-ground adjoining the *Chance* creek lease on the west. Previous to 1932 the ground had been worked in an unsystematic manner by "lay-men." Subsequent to that time the present interest entered the picture and commenced a systematic plan of operation.

The *Chance* creek lease covers the coincidence of the old channel with Spruce Creek, up-stream from the Morse-Bratt workings. South-easterly of this the *Goodwill* bench lease covers the up-stream continuation of the old channel under the high bench north of the second canyon to its repeated coincidence with, and crossing of, Spruce Creek in the *Sunlight* creek claim.

The workings consist of a vertical shaft, 93 feet deep, at the south rim-side of the old channel, on the north boundary of the easterly end of the *Chance* claim. From this a crosscut north-east for 300 feet extends to about the centre line of the old channel. Two main north and south drifts extend up-stream from the crosscut, to drainage and crosscut connections with a vertical shaft 203 feet deep on the south rim-side of the old channel in the south-westerly corner of the *Sunlight* creek claim and about 1,500 feet from the lower shaft. At the time of examination the workings had progressed about 300 feet up-stream (south-easterly) from the upper shaft. In the new workings of the upper-shaft section the main drifts are about 60 feet apart and the ground is blocked by crosscuts between and lateral to them. In the section of the old workings the drifts meander irregularly along the north and south sides of the channel and vary from 60 to over 200 feet apart, with irregular sectional and lateral cross-cutting. The workings are dewatered by drainage to pump-sumps at the shafts, but this would be greatly facilitated by a bed-rock drainage connection with the drainage system of the Morse-Bratt workings. The easterly section of the workings up-stream from the old "lay" workings are systematized into a series of blocks between the main north and south drifts. About 180 feet along the lower shaft crosscut, branch drifting and crosscutting extends 420 feet north along flat, decomposed bed-rock and encounters at this point a steep drop-off of bed-rock to the north which is probably a local gut or depression along the north rim in this locality.

At the time of examination (end of July) work was being carried on with a crew of sixty men. In the old workings about 1,000 feet of ground tributary to the lower shaft was in process of being "cleaned up." Mining in four faces in this section, mostly in marginal ground, at the rate of 6 "sets" per week, was being carried on with a reported recovery of 96 oz. from twenty-four "sets." Two places in this area are reported to have returned 48 oz. from 6 "sets."

In the new workings tributary to the upper shaft five faces were being worked at the rate of eighteen "sets" per week with a reported average recovery of 80 to 100 oz. from eighteen "sets." In this section the best values, averaging 4 to 5 oz. to the "set," occur across a width of 60 to 80 feet and the workings are carried to marginal ground running about 2 oz. to the "set." In some sections along the channel centre line values of 10 to 12 oz. to the "set" are reported. At the extreme easterly workings, flat, decomposed bed-rock of the old channel reported to carry the average cited values extends across a width of 138 feet.

In both the upper and lower shaft areas faces are carried about 6 feet high, including about 2 to 2½ feet in decomposed bed-rock. As the best values in the Spruce Creek old channel occur in and on top of bed-rock this is the general mining practice along the creek. At both the shafts test-slucies are maintained, and for the direction of the workings values are ascertained by sluicing a known number of cars from definite sections.

This bench lease adjoins the *Sunlight*, a southerly fraction of the *Canyon Dream Lease*. lease and the adjoining *New Year* lease on the south. It is owned by G. Nolan, of Atlin, who holds an option on the *New Year*. The ground covers the projected south-easterly extension from the *Sunlight* ground of the old channel under the south bench of Spruce Creek. In former years a shaft was sunk by Nolan in glacial drift in the south-westerly corner of the *Canyon* lease. This is filled with water, but is reported to have encountered rim-rock at a depth of 60 feet sloping steeply south.

Towards the close of the 1936 season a shaft was started at elevation 3,250 feet in the north-west corner of the *Dream* lease and about 850 feet easterly of the Colpe Mining Company's upper shaft on the *Sunlight*. Correlation with the extreme easterly workings on the *Sunlight* indicates the position of this shaft to be within the area of the projected up-stream continuation of the old channel, with bed-rock estimated to be at a depth of 218 feet. In the intervening stretch between this point and the Blue Canyon area no work is being or has been done along the projected course of the old channel. This is deep ground and values should be ascertained by drilling.

Blue Canyon.—In this section there are opportunities for shallow digging by individuals in post-Glacial wash-gravel overlying clay bed-rock, on low benches along Spruce Creek trough and on rim-rock in and above the canyon. Former and present individual shovelling-operations indicate a possible appreciable extent of fine gravel worthy of exploration for possible operation by steam-shovelling or dredging with modern dredge equipment.

On the north bank of Spruce Creek, about 1 mile above Rant Creek, A. T. Abbot has been shovelling shallow ground for several years from various places on a creek lease and claim. In 1936 he was shovelling fine top gravel in two places, 3 and 4 feet down from grass-roots, and recovering low values. In this section the creek-trough is 100 feet wide between moraine benches 30 feet high.

About three-quarters of a mile above Abbot's workings H. G. Marshall is shovelling-in from the creek-trough in pits and cuts 6 to 11 feet deep to hard-pan. It is of interest to note that this man has been shovelling-in this section continuously since 1900. The gold recovered is moderately fine and the ground is reported to seldom return below about 30 cents to the cubic yard. Two other individuals were working intermittently on shallow rim-ground in and above Blue Canyon.

SPECIAL REPORTS.

A limited number of mimeographed copies are available to those who specially request reports on the following properties:—

Bush Consolidated Gold Mines, Limited.

Pay Roll.

Parvati Group.

The properties described in these reports are not considered to have reached a stage of development that would be of sufficient interest as yet to warrant the inclusion of lengthy descriptions in the Annual Report.

PROGRESS NOTES.

LODE-GOLD DEPOSITS.

BY

CHARLES GRAHAM.

COAST AREA.

Surf Point Mine.—Operated by N. A. Timmins Corporation, Limited; R. E. Legg, manager. The mine and mill operated continuously during the year. A second exit to the mine has been provided by driving a second level through to the outside. Ventilation is natural. The output from the mine is about 40 tons per day. This is put over a sorting-table, as it contains considerable waste, before being put through the mill, which has a capacity of about 22 tons per day.

Developments during the year consisted of 194 feet of drifting, 28 feet of crosscutting, 114 feet of raising, and 1,428 feet of diamond-drilling; 15,215 tons of ore was mined, and this yielded 3,374 oz. gold and 1,219 oz. silver.

Edye Pass Mine.—Operated by the Reward Mining Company, Limited; Alex. Smith, manager. Active development-work has been carried out since the property was acquired in May. The property adjoins the *Surf Point* mine. An adit has been commenced about 150 feet above sea-level and close to the shore-line. This has been driven in approximately 500 feet,

from which point crosscutting has been done to intersect the ore-bodies exposed on the surface by stripping. About 1,020 feet of crosscutting has been done and 482 feet of drifting; 112 tons of ore was shipped to the smelter, and this yielded 122 oz. gold and 41 oz. silver. There were sixteen men employed.

A Diesel-driven air-compressor, capacity 450 cubic feet, has been installed. A cook-house, bunk-house, and dry-room have been built. The drift and crosscut are ventilated by small fan and air-pipe.

Surf Inlet Mine.—Surf Inlet Consolidated Gold Mines, Ltd., owners; Angus McLeod, superintendent. There was a change of control of this property early in the year and since that time development has been active. Operations are at present confined to the *Pugsley* vein, which was formerly worked by the old Belmont-Surf Inlet Mines.

The inclined shaft has been sunk to the 1,100-foot level and development on that level has been commenced. Considerable drifting has been done on the 1,013N and 1,014S levels off the 1,000-foot level and stoping on these levels has been started.

Some stoping is also being carried on in an old stope above the 800-foot level.

Additional ventilation was suggested for the 1,000-foot level and a fan and air-pipe was ordered.

The old mill has been overhauled and is operating on a part-time schedule.

The power plant and the mine buildings of the old company are being used.

Skidegate Gold Mines, Ltd.—W. G. Smith, manager. This property is situated about 1 mile inland from the east coast near the Indian village of Skidegate, about 6 miles from Queen Charlotte City, at the south-east end of Graham Island.

Some further development-work has been done at the mine and the property went into production early in November. A Hadsel mill, 70-ton capacity, has been erected and is now in operation. This is the only new mill brought in in the Northern District during the present year. A self-acting incline has been built from the mine to the mill, using a self-dumping car of 2-ton capacity.

Development during the year consisted of 200 feet of drifting, 70 feet of crosscutting, and 200 feet of raising; 500 tons were milled with a gold-recovery of 0.13 oz. per ton.

BEAR RIVER AREA, PORTLAND CANAL.

Dunwell Mine.—Operated by the Welldun Mining, Milling, and Power Company, Limited; L. S. Davidson, manager. The mining here was done on contract on the basis of the gold and silver content of the ore. Only one stope was operated, six men being employed. The *Dunwell* mill operated for most of the year, doing some custom-work in addition to milling the ore from the *Dunwell* mine. During the year a small amount of development-work was done; 4,585 tons of ore was mined, and this yielded 990 oz. gold, 35,676 oz. silver, and 146,125 lb. lead.

A group of claims were staked by the Premier Gold Mining Company, Limited, across the Bear River just opposite the town of Stewart, and a crew of men was engaged for several months prospecting and open-cutting.

Adjoining the above group, John Haahti and associates are actively working on another group of claims recently staked. One of the veins has been traced for over 300 feet.

SALMON RIVER AREA, PORTLAND CANAL.

Silbak Premier Gold Mines, Ltd.—B. F. Smith, general manager; J. C. Pearcey, mine superintendent. An amalgamation of the *Premier*, *B.C. Silver*, *Sebakwe* properties took place on January 1st, 1936, and these are now operated as the Silbak Premier Gold Mines, Limited; the operating staff of the *Premier* mine remaining in charge of the consolidated properties.

Considerable development-work totalling 12,264 feet of drifting and raising was done, all of which was in the *B.C. Silver* and *Sebakwe* sections. A considerable amount of diamond-drilling was also done in the new sections during the year. The mine operated 313 days.

Development during the year consisted of 5,563 feet of drifting, 932 feet of crosscutting, 3,645 feet of raising, 2,124 feet of side-swiping, and 27,933 feet of diamond-drilling. Tonnage mined was 192,442 tons, and this yielded 43,166 oz. gold and 996,488 oz. silver.

Big Missouri Mine.—Buena Vista Mining Company, Limited, owners; Consolidated Mining and Smelting Company, operators; D. S. Campbell, general superintendent; E. James, mine

superintendent. Development has been continuously carried on during the year; 2,591 feet of drifting and raising and 13,734 feet of diamond-drilling having been done.

It has been decided to erect a mill of 750 tons capacity; the mill will be located underground below the 2,350-foot level on the Salmon River side of the ridge. An adit has been driven in at the 2,150-foot level to the mill-site, which will be about 600 feet in from the portal. The mill excavation will be about 60 feet wide and 40 feet high and will be on the necessary grade through to the bunkers below the 2,350-foot level. The machine-shops will also be located underground at the mill-site.

A power-development has been commenced at Long Lake to furnish approximately 2,300 horse-power. The power-house has been erected, but unfortunately exceptionally high water did considerable damage to the dam before construction was completed and this work had to be postponed until spring; 1,320 feet of tunnelling and open-cutting had to be done from the power-plant site through the ridge to Long Lake for the pipe-line. The mill-construction will be continued during the winter.

A new bunk-house and dry-room have been built.

Hercules Group.—Diamond-drilling was continued on this group by the Consolidated Mining and Smelting Company during the summer months.

Salmon Gold Mines, Ltd.—This property is situated on the west side of Summit Lake, about 8 miles from *Big Missouri*, and is under option to the Consolidated Mining and Smelting Company. Considerable diamond-drilling has been done. During the summer a crosscut adit was started at an elevation of 800 feet above the lake to intersect the ore-body. On account of the difficulties of transportation during the winter season, operations were suspended in October. Provision has been made for an early start in 1937.

A number of prospectors did assessment-work on other properties during the summer.

UNUK RIVER AREA.

The Premier Gold Mining Company continued prospecting on the claims of the McKay Syndicate with a crew of fifteen men. Several other groups of prospectors were engaged in the district during the summer. About forty men, all told, were in the area during the summer.

AMERICAN CREEK DISTRICT.

Excelsior Group.—Early in the year some equipment was brought in for this property to be taken in over the snow, but owing to severe handicaps on the trail they were unable to get it all in.

Kansas Group.—A small shipment of high-grade ore was made from this property to the Tacoma smelter. Two men are continuing work during the winter.

BITTER CREEK DISTRICT.

Roosevelt Group.—Considerable work was done here during the spring and early summer, consisting principally of drifting on the vein.

Assessment-work was carried on on several of the other groups of claims in this area.

MARMOT RIVER DISTRICT.

Sure Thing Group.—J. K. Green had a few men who did some further development-work on this group.

Assessment-work was done on several other groups of claims.

MCDAME CREEK AREA.

Considerable prospecting for lode gold has been carried on in the McDame Creek area; good results are reported.

The *Vollaug* group, a new discovery on Table Mountain, was bonded to the Consolidated Mining and Smelting Company of Canada. This discovery appears from reports to be of considerable interest.

SILVER-LEAD-ZINC DEPOSITS.

ALICE ARM SECTION.

Esperanza Mine.—Operated by the Esperanza Mines, Limited; L. H. Wenerstrom, manager. This mine is situated in the Alice Arm District and operated throughout the year.

Development consisted of 134 feet of drifting and 75 feet of raising; 1,320 tons of ore was mined, and this yielded 37 oz. gold and 13,917 oz. silver. There were twenty-two men employed during the year.

BEAR RIVER AREA.

Lakeview Mining Co., Ltd.—The property was operated under lease to Henry Rochfort, who had five men employed. They stripped the lead on the surface for a distance of about 125 feet and worked an open-cut. The ore was sorted on the ground and shipped to the Dunwell mill.

United Empire Gold and Silver Mines, Ltd.—Wm. Dann, manager. The mine, which was closed down early in 1935, was reopened on July 12th and was again closed in November. During that time 80 feet of drifting, 12 feet of crosscutting, and 63 feet of raising were done. Some ore was shipped to the Dunwell mill for testing.

Several other small properties shipped a few tons of ore to the Dunwell mill.

PLACER-GOLD DEPOSITS.

ATLIN AREA.

Boulder Creek.

Consolidated Mining and Smelting Co.—McLeod White, superintendent. This is now a hydraulic operation, underground work having been abandoned. Operations have been moved a considerable distance up-stream from the old underground work, and much better results have been obtained. Only one monitor operated part time on two shifts on account of water-shortage.

McKee Creek.

Atlin Gold Mines, Ltd.—George Adams, lay-man. This is a hydraulic operation employing eight men. Water-shortage prevented full-time operations.

Otter Creek.

Compagnie Francaise des Mines d'or du Canada.—Walter Sweet manager. This is an underground operation and is run by lay-men.

Moran Tunnel.—Gibbs and Findleyson, lay-men. Only the two lay-men employed.

Shaft Lay.—W. Sweet and partners, lay-men. Six men employed all partners in the "lay." The two drifts being driven up-stream struck sand and had to be abandoned as the ground could not be held. A drift was driven up on the rim to get around the sand deposit.

Ruby Creek.

Blackstoen Lease.—E. Krumbeigel, owner and operator. This is a shaft operation. Shaft was down 151 feet through lava and had just entered the gravels under it. A fan is to be installed which will improve the ventilation at the bottom of the shaft. Three men were employed.

Surprise Lake Mining Co.—Matson and partners, lay-men. This is a hydraulic operation employing five men who are all partners in the "lay."

Two other small underground operations on the creek were inspected.

O'Donnel River.

There are seven small underground operations on this creek, one on Blind Creek, and one on Slate Creek, both tributaries of O'Donnel River. Only the lay-men are working on these properties, all of which are bench operations.

Wright Creek.

Hodges and Moran are operating a hydraulic on which four men are employed. There is a shortage of water except for a short time at the beginning of the season. Underground operations are being considered on that account.

Several other individuals are ground-sluicing farther up-stream.

Birch Creek.

One small underground and several small ground-sluicing operations are being conducted on this creek.

Wilson Creek.

Several individuals were engaged in prospecting and ground-sluicing. Most of the future work here will be underground.

SQUAW CREEK DISTRICT.

Ten small operations employing twenty-seven men are being carried on here. This creek runs into Yukon Territory about 125 miles west of Atlin.

UNUK RIVER AREA.

Unuk River Placer Gold Co., Ltd., has been doing some prospecting on a 5-mile placer lease on Sulphide Creek. A small placer-drill was taken in and eighteen holes were drilled.

MCDAME CREEK AREA.

Some placer-mining is carried on in this area, consisting principally of surface operations. There is also some activity on Thibert Creek.

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