PART A

ANNUAL REPORT

OF THE

MINISTER OF MINES

OF THE PROVINCE OF

BRITISH COLUMBIA

FOR THE

YEAR ENDED 31ST DECEMBER

1936

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:
Printed by CHARLES F. BANFIELD, Printer to the King's Most Excellent Majesty.
1937.

BRITISH COLUMBIA DEPARTMENT OF MINES.

VICTORIA, B.C.

HON. GEORGE S. PEARSON - - - - - - - *Minister of Mines.*
JOHN F. WALKER - - *Deputy Minister and Provincial Mineralogist.*
D. E. WHITTAKER - - - - *Provincial Assayer and Analyst.*
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R. J. STEENSON - - - - - - - *Chief Gold Commissioner.*

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JOHN G. BIGGS, Princeton.
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Mine-rescue Station Instructors.

RICHARD NICHOL, Nanaimo.
A. GOULD, Princeton.
J. L. BROWN, Cumberland.
J. T. PUCKEY, Fernie.

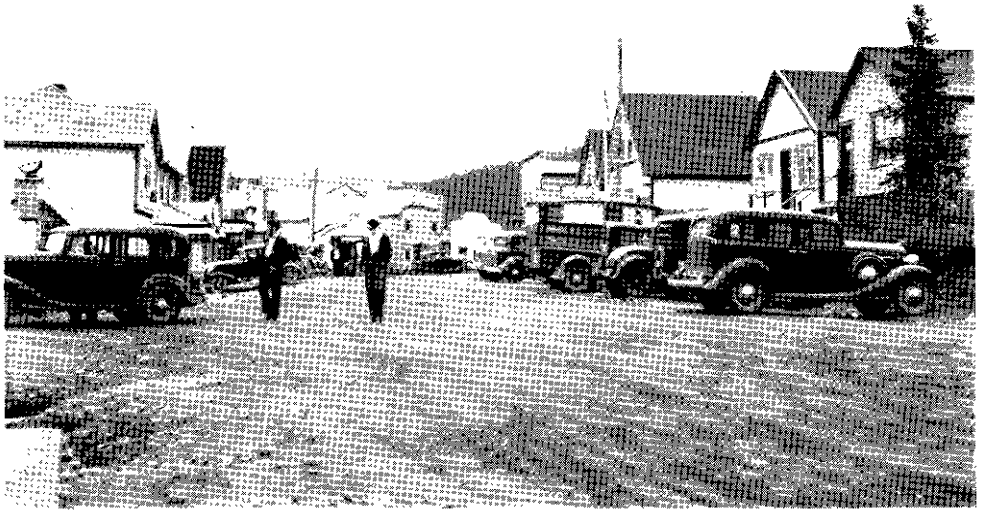
To His Honour ERIC WERGE HAMBER,
Lieutenant-Governor of the Province of British Columbia.

MAY IT PLEASE YOUR HONOUR:

The Annual Report of the Mining Industry of the Province for the year 1936 is herewith respectfully submitted.

G. S. PEARSON,
Minister of Mines.

Minister of Mines' Office,
May, 1937.



Main Street of Wells, 1936.

Main Street of Barkerville, 1936.

PART A.

THE MINING INDUSTRY.

BY

JOHN F. WALKER.

The value of mine production in 1936 was $54,081,967, an increase of $5,260,728 over 1935. This increase is particularly gratifying in view of the appreciably smaller tonnage of ore mined from base-metal properties, which means that a better price for base metals has been obtained throughout the year as compared with 1935.

Lode-gold production, which in recent years has been establishing records in both volume and value, showed a further increase of 10.7 per cent. in volume and 10.2 per cent. in value for 1936 as compared with 1935. Placer gold, with a value of $1,249,940, is the highest since 1900. The increase over 1935 was 40.3 per cent. in volume and 39.6 per cent. in value. The combined value for lode and placer gold of $15,418,594 is the greatest for any one metal or material for the year.

Lead is a close second to gold, with a value of $14,790,029 and an all-time record volume production of $377,971,618 lb. The volume increase was 9.8 per cent. and the value increase 37.2 per cent. as compared with 1935.

Zinc production fell slightly short of the 1935 volume record with a loss of 0.7 per cent., but the increase in value showed a gain of 6.1 per cent.

Coal, valued at $5,772,502, occupied fourth place with an increase in volume and value of 13.3 per cent.

Silver production increased in volume 2.9 per cent., with a value decline of 28.3 per cent., to $4,296,548.

Copper decreased in volume by 46.4 per cent. and in value by 34.8 per cent. to $1,971,848, the lowest since 1900. The smaller decrease in value as compared to volume shows a better average price for the metal during the year.

Non-metallic minerals and structural materials, with the exception of a few minor minerals and materials, showed substantial gains, amounting in the aggregate to over 30 per cent. This is a healthy sign, as it reflects activity in building and construction.

The total number of shipping-mines decreased from 177 to 168; those shipping over 100 tons decreased from 72 to 70.

The number of men employed increased from 13,737 to 14,180 and wages and salaries increased from $16,753,367 to $17,917,221.

Dividends increased from $7,386,070 in 1935 to $10,513,705 in 1936. These figures do not include dividends paid by Howe Sound Mining and Smelting Company, parent company of the Britannia Mining and Smelting Company, or the capital disbursements by the Granby Consolidated Mining, Smelting, and Power Company.

During the past three years new tables have been compiled, the first of which, Table No. I., appeared in the 1933 Annual Report.

For the 1934 Annual Report, Table VI. (now Table VII.), which formerly tabulated the yield of placer gold only, was drawn up to show both placer- and lode-gold values. This facilitates a rapid view of the total gold production of the Province. Another table introduced in 1934, No. XXII., includes "Mining Companies employing an Average of Ten or More Men." Incorporated in this table, additional data are presented showing the number of operating days at mine and mill, and also tonnage mined and milled. A subsection of the table shows operating days and average men employed at non-shipping mines employing ten or more men.

For the Annual Report for 1936, a new table, No. II., gives average metal prices used in compiling Provincial Production, for the years 1901–1936, inclusive, for gold, silver, copper, lead, and zinc.

Table IX.A, is a reprint of a similar table printed in the 1933 Annual Report, but with the values of both placer- and lode-gold ounces valued at the average value of gold per fine

ounce, instead of the old standard price of $20.671834. This table should be referred to when making comparisons with 1933 and 1932 gold production value.

Table No. VIII. has been extended to cover a period of five years' production by mining divisions and districts, in place of the three-year period formerly given.

Table No. XVII. is a new table for 1936 Annual Report, and covers dividends paid by mining companies in British Columbia. The information has been obtained from departmental files, operators, and trade journals, and while in general is accurate, there may be slight differences in isolated instances.

Table No. XVIII. is also a new table for 1936, and sets forth capital employed, salaries and wages, amount expended on fuel and electricity, and process supplies for the year 1936, with comparative figures for 1935. The table shows details of such subjects by districts, under the various classes of mining. The totals are those obtained from all returns made to the Department on the subject, but there are some returns not received in time to be included in the totals, nor does it take into account the amounts expended in the large number of small operations conduced by one or two individuals or prospectors.

Table No. XIX. is a former table enlarged to show a period from 1901 to 1936, inclusive, covering tonnage, number of mines, number of mines shipping over 100 tons, and net value to shipper of lode-minerals. A new feature in the table also is the gross value of lode-minerals produced. It will be observed that the " net value " is not given for the years previous to 1926; such was not given on returns filed by operators.

Table No. XX. is a former table showing number of men employed in the mining industry. Formerly the table gave the current year and one comparative year, but the present table covers the period 1901 to 1936, inclusive.

GENERAL SITUATION.

It is even more difficult to forecast the value of the mining industry for 1937 than it was to forecast it for 1936.

It is anticipated that lode gold will again show an increase in volume, and it is believed that the average price will be about the same. Placer gold should show a further marked increase in volume and value production.

Silver production and value are expected to be about the same as in 1936.

Copper should show an appreciable gain in volume, due to return to capacity production of Britannia and reopening of the *Copper Mountain* property of Granby Consolidated Mining, Smelting, and Power Company, about June 1st. It is impossible to forecast the average price for copper, which in the first four months of 1937 has increased from 11.8 to 17 cents per pound and has recently dropped to 14.9 cents per pound. However, if copper should average 12½ cents per pound, almost the low for the year to date, there should be, due to increased volume production, an increase in value of about $3,000,000 as compared to 1936. It is quite possible that this figure may be further increased by $750,000 to $1,000,000.

The volume of lead production may well show a slight increase, and with an almost assured increase in average price the value increase for the year may be anywhere from $3,750,000 to $7,000,000.

Zinc production is likely to be about the same in volume, but it is anticipated that the value will be considerably higher. Zinc, like copper and lead, has risen rapidly in price and then declined during the past four months, but a fair average for the year suggests an increased value of close to $5,000,000.

Coal may be expected to show a further increase in volume and value.

Structural materials should show a further increase, but it is not anticipated that it will be as great as that of 1936 compared with 1935.

In preparing the foregoing estimate, it is assumed that no major disaster will affect the mining industry or any of the larger producers. If the industry functions smoothly throughout the year, it is anticipated that the value of mine products may establish an all-time high record. If this is attained, it will be all the more gratifying, as it is not likely to be the result of a record tonnage output, but due to appreciably better metal prices.

Prospecting throughout the Province, though active, is not being carried on to as great an extent as it should be to assure the discovery of new properties which will replace those now in production, and to which there must inevitably be an end. However, two properties

are being brought into production in the North-west Mineral Survey District, one, the *Big Missouri*, a fairly old discovery, but the other, the *Whitewater* property of Polaris Taku Mining Company, Limited, a discovery of more recent years. An interesting discovery was also made last year in the McDame Creek area which is under development this year by the Consolidated Mining and Smelting Company of Canada.

The Manson section in North-eastern Mineral Survey District is now considered to have passed the prospect stage and production is expected on a profitable basis.

In the Cariboo area the recent developments by Consolidated Gold Alluvials of British Columbia will be watched with great interest throughout the year, as this property has now reached a stage where the future of this type of mining will soon be known.

In the Southern and Central Mineral Survey District the Hedley Camp will probably attract the greatest amount of attention during the coming season, and development is anticipated at a number of prospects and small properties. The reopening of the *Copper Mountain* property of Granby Consolidated Mining and Smelting Company is creating considerable employment in the Princeton area, and will no doubt again stimulate interest in that section.

In the Eastern Mineral Survey District the Slocan, due to current lead and zinc prices, is again attracting considerable attention, and a number of old properties are being reopened. It must be remembered, however, that the present price of zinc at a little over 5 cents per pound does not make the low-grade zinc properties attractive. The interest created in these properties was largely due to the recent high price of over 7 cents a pound.

In the Western Mineral Survey District the return of the Britannia Company to capacity production is perhaps the most important feature. The possibility of B.C. Nickel getting into production before the year is out is also of interest, as this is likely to be the first nickel-producer in Western Canada. Gold-mining is still active at various places, and interest is again being revived in base-metal properties.

GOLD PURCHASING.

Late in 1935 the Department of Finance, co-operating with the Department of Mines, undertook to purchase small lots of placer gold under 2 oz. in weight from the individual placer-miner. The Gold Commissioners throughout the Province have paid a cash price of $28 per ounce for clean gold, and have purchased dirty gold and amalgam on a deferred-payment basis. During 1936, 1,470 lots of gold were received by the Department through the Gold Commissioners, of an aggregate value of some $50,000. The total price paid is almost exactly the same as that received from the Royal Canadian Mint, except for the Mint's handling charges of 1 per cent. The service for the year has cost the Government about $500, and considering that the individual miner has received about $10,000 to $12,000 more than had he sold through the ordinary channels, this service is believed to be well justified.

DEPARTMENT LABORATORIES.

During 1936 the Assay Office has been equipped with a new electric furnace and drying-oven and other accessories to bring it thoroughly up to date. The laboratories of the Mineralogical Branch have been equipped for the first time in the history of the Department with the finest microscopic equipment available. The work of the technical staff, by reason of this new equipment, will not only be increased in value, but the Department is prepared to offer a greater service to the public in the examination of mill products, etc., than heretofore. The laboratory is at present being equipped for research-work in respect to non-metallic and structural materials, where preliminary investigations may be made preparatory to more intensive work in the well-equipped laboratories of the Department of Mines in Ottawa.

LECTURES TO PROSPECTORS.

A series of fourteen lectures on geology and mining, prepared by the Provincial Mineralogist in 1934, was again presented during the winter of 1936–37 by the Resident Mining Engineers and other instructors at the following centres throughout the Province:—

Alice Arm, Bralorne, Burnaby (2), Creston, Fernie, Fort Steele, Wild Horse Creek, Galloway, Kelowna, Mayook, Nanaimo, Nelson, New Hazelton, North Vancouver, Penticton, Premier, Prince Rupert, Prince George, Princeton, Revelstoke, Smithers, Usk, Vancouver (2), Victoria, Williams Lake, and Wynndel.

The estimated total average attendance at the lectures prior to the completion of the course was 800. This work was carried out in conjunction with the Department of Education, and it is expected that the lectures will be given during the winter of 1937–38.

The preparation of rock and mineral sets comprising about fifty minerals and rocks commonly found in British Columbia has been going ahead for some time, and distribution started about the end of the year. A nominal charge of 50 cents a set is made, and it is expected that during 1937 about a thousand sets will be distributed throughout the Province.

PLACER MINING CAMPS.

The Provincial Government Department of Labour created in 1935 a plan whereby unmarried, physically fit unemployed men between the ages of 21 and 25 years were given an opportunity to learn placer-mining. In 1936 the age-limit was reduced, permitting younger men to enrol. Instruction was carried out under the direction of the Senior Engineer. The Nanaimo River and Emory Creek Camps only were used and enlarged to permit the training of larger groups than in 1935. The staff of the Nanaimo Camp consisted of an instructor in placer-mining, a cook-instructor, and timekeeper; and at Emory Creek a chief instructor and assistant instructor, a chief cook-instructor and an assistant cook-instructor, and a timekeeper. In addition to the above, some of the trainees were given, when necessary, the position of overseer and took charge of groups of trainees.

The trainees were instructed in simple methods of placer-mining, in the art of camp cooking, and how to look after themselves in the hills. This included first-aid instruction. Food and equipment supplied was similar to that used by prospectors.

Instruction lasted from a month to six weeks, according to ability to learn. Fifty men were trained in the Nanaimo Camp and 100 in the Emory Creek Camp at a time, and in all a total of about 300 men received training during the year. About 50 per cent. of the trainees availed themselves of the opportunity of a grub-stake equivalent to the relief allowance of $9.60 per man per month, and went to various parts of the Province. The Nanaimo Camp opened the latter part of June and both camps were closed about the end of September.

GEOLOGICAL SURVEY OF CANADA.

By an arrangement made at the time the Province of British Columbia entered Confederation, all geological investigations and mapping in the Province were to be carried on by the Geological Survey of Canada; this agreement has been fully adhered to by the Dominion Government and has proved of great benefit to the mining industry of the Province. Each year several geological parties are kept in the field and in the aggregate a vast amount of information is made available to the prospector and the mining engineer in the many excellent reports and maps covering British Columbia which have been issued by the Geological Survey of Canada.

For some years a branch office of the Geological Survey has been maintained in Vancouver, where copies of maps and reports on British Columbia can be obtained. The officer in charge of the British Columbia office is W. E. Cockfield and the address is 511 Winch Building, Vancouver, B.C.

In 1936 a reorganization of several departments in the Federal Government was effected, and the Department of Mines and Resources created. One of the main branches of this Department is that of Mines and Geology, with sub-branches known as the Bureau of Geology and Topography and the Bureau of Mines. The Geological Survey of Canada is now a part of the Bureau of Geology and Topography.

During the season of 1936 the Geological Survey of Canada had the following officers employed on geological field-work in British Columbia:—

GEOLOGICAL PARTIES.

1. E. D. Kindle examined the mineral properies north and east of Usk, in an area tributary to the Canadian National Railways.

2. E. J. Lees studied and mapped the geology of the west half of Smithers map-area (lats. 54°–55°, longs. 127°–128°).

3. M. F. Bancroft examined the mineral properties in the Smithers district.

4. J. E. Armstrong commenced the study and mapping of the geology of the west half of Fort Fraser map-area (lats. 54°–55°, longs. 125°–126°).

5. J. G. Gray commenced the study and mapping of the geology of the east half of Fort Fraser map-area (lats. 54°–55°, longs. 124°–125°).

6. A. H. Lang completed the study and mapping of Keithley Creek map-area (lats. 52° 45′–53°, long. 121°–121° 30′).

7. N. F. G. Davis made a detailed study of the north-western part of the Barkerville Gold Belt in the vicinity of Island Mountain.

8. D. A. McNaughton made a detailed study of the mineral properties in Greenwood area.

9. C. E. Cairnes and C. Tolman studied and mapped the geology of the west half of Kettle River map-area (lats. 49°–50°, longs. 119°–120°).

10. H. M. A. Rice studied and mapped the geology of the east half of Nelson map-area (lats. 49°–50°, longs. 116°–117°).

TOPOGRAPHICAL PARTIES.

1. R. C. McDonald mapped, for publication, on 1 inch to 1 mile with 100-foot contours, an area in the vicinity of Tyaughton Lake.

2. A. C. Tuttle mapped the east half of the Nelson sheet (lats. 49°–50°, longs. 116°–117°) for publication on a scale of 1 inch to 4 miles with 500-foot contours.

3. R. J. Parlee and H. A. S. West mapped the Manson Creek sheet (lats. 55°–56°, longs. 124°–126°) for publication on 1 inch to 4 miles with 500-foot contours.

4. C. H. Smith and F. P. Duvernet mapped the Hazelton sheet (lats. 55°–56°, longs. 126°–128°) for publication on a scale of 1 inch to 4 miles with 500-foot contours.

METHOD OF COMPUTING PRODUCTION.

The total mine output of the Province consists of the outputs of metalliferous minerals, coal, structural materials, and miscellaneous metals, minerals, and materials, valued at standard recognized prices in Canadian funds.

In the Annual Report for 1925 some changes were made in the methods used in previous years in computing and valuing the products of the industry, but in order to facilitate comparisons with former years the same general style of tables was adhered to. The methods used in the 1925 Annual Report have been followed in subsequent Annual Reports, with the addition of new tables.

The following notes explain the methods used:—

(1.) From the certified returns of lode mines of ore and concentrate shipments made during the full calendar year by the producers the net recovered metal contents have been determined by deducting from the "assay value content" necessary corrections for smelting and refining losses.

In making comparisons of production figures with previous years, it should be remembered that prior to 1925 in the Annual Reports the total metal production, with the exception of copper, was determined by taking the assay value content of all ores shipped; deductions for slag losses were made by taking varying percentages off the metal prices.

(2.) Gold-placer returns are received from operators giving production in crude ounces recovered; these are converted to fine-gold ounces by dividing the crude-ounce value by the old standard price of gold. The fine-gold content is then valued at the yearly average price of gold, which in 1936 was $35.03 per ounce. On this basis the average crude-gold value per ounce was $28.80 on Provincial placer-gold production.

(3.) The prices used in valuing the different metals are: For gold, the average price for the year; for silver, the average New York metal-market price for the year; for lead, the average London metal-market price for the year; and for zinc, the average London metal-market price for the year. As in 1934, copper in 1935 is valued at the average London metal-market price. Prior to 1932 copper was valued at the average New York price. The change was made because very little copper was being marketed in the United States on account of high tariff charges against importations from foreign countries. The bulk of the lead and zinc production of the Province is sold on the basis of the London prices of these metals and they are therefore used. The New York, St. Louis, and Montreal lead- and zinc-market prices differ materially from the London prices of these metals and are not properly applicable to the valuing of the British Columbia production.

By agreement with the Dominion Bureau of Statistics and the Provincial Statistical Bureaus, the following procedure of taking care of the exchange fluctuations has been agreed upon:—

(*a.*) Silver to be valued at the average New York price, adjusted to Canadian funds at the average exchange rate.

(*b.*) Lead, zinc, and copper to be valued at London prices, adjusted to Canadian funds at the average exchange rate.

(4.) In 1926 a change was made in computing coal and coke statistics. The practice in former years had been to list coal and coke production (in part) as primary mineral production. Only the coke made in bee-hive ovens was so credited; that made in by-product ovens was not listed as coke, but the coal used in making this coke was credited as coal production. The result was that the coke-production figures were incomplete. Starting with the 1926 Annual Report, the standard practice of the Bureau of Statistics, Ottawa, has been adopted. This consists of crediting all coal produced, including that used in making coke, as primary mine production. Coke-making is considered a manufacturing industry. As it is, however, of interest to the mining industry, a table included in the Report shows the total coke produced in the Province, together with by-products, and the values given by the producers. This valuation of coke is not, of course, included in the total gross mine production of the Province.

From 1918 to 1930 coal production was valued at $5 per long ton. In 1931 the price used was $4.50, and in 1932, 1933, 1934, and 1935 the price used has been $4.25 per long ton. In making comparisons with former years the decline in dollar value is accentuated by this lowered price.

Robert Dunn, Deputy Minister of Mines for British Columbia for eleven years, died on November 26th, 1936, and with his passing the mining industry lost a true friend and able administrator.

Robert Dunn was born in Toronto, Ontario, in 1884, and came to British Columbia in 1891, receiving his education at the Victoria Public and High Schools. He had a wide experience in journalistic work on the editorial staffs of the Victoria *Colonist* and *Times*, and left the News Editor's chair of the latter paper in 1917, to become Secretary to the late William Sloan, at that time Minister of Mines. After eight years' service in that capacity he was appointed Deputy Minister.

He was greatly interested in the youth of the city and took an active part in Boy Scout affairs. He was a member of the Union Club and the Uplands Golf Club.

All those who had anything to do with the mining industry and the Department of Mines will long remember his courtesy and kindly consideration in their dealings with him.

INDEX TO TABLES.

TABLE I.—British Columbia Mine Production, 1935 and 1936.

	Quantity, 1935.	Quantity, 1936.	Value, 1935.	Value, 1936.	Per Cent. Increase (+) or Decrease (—).	
					Quantity.	Value.
Metallics.			$	$		
Bismuth			6,584	357,007		
Cadmium			441,203	468,170		+ 6.1
Copper lb.	38,791,127	20,805,672	3,023,768	1,971,848	— 46.4	— 34.8
Gold, lode* oz.	365,244	404,472	12,852,936	14,168,654	+ 10.7	+ 10.2
Gold, placer* oz.	30,929	43,389	895,058	1,249,940	+ 40.3	+ 39.6
Lead lb.	344,268,444	377,971,618	10,785,930	14,790,029	+ 9.8	+ 37.2
Platinum oz.	39	23	1,275	930	— 41.0	— 27.0
Silver oz.	9,251,544	9,521,015	5,994,075	4,296,548	+ 2.9	— 28.3
Zinc lb.	256,239,446	254,581,393	7,940,860	8,439,373	— 0.7	+ 6.1
Others				49,971		
Totals			41,941,689	45,792,470		+ 9.2
Fuel.						
Coal (2,240 lb.) tons	1,187,968	1,346,471	5,048,864	5,722,502	+ 13.3	+ 13.3
Non-metallics.						
Diatomaceous earth			428	350		— 15.9
Fluxes—limestone, quartz tons	36,378	17,592	36,673	14,555	— 51.6	— 60.3
Gypsum products, gypsite			84,982	124,425		+ 46.4
Iron oxides			1,670	4,000		+ 139.5
Slate and green rock granules; talc tons	390	268	4,293	2,809	— 5.6	— 32.1
Sodium carbonate, magnesium sulphate tons	584	845	10,395	15,389	+ 44.9	+ 48.0
Sulphur† tons	46,783	64,896	453,528	608,790	+ 39.1	+ 34.2
Totals			591,969	770,318		+ 30.1
Clay Products and other Structural Materials.						
Clay Products.						
Brick—						
Common No.	2,388,451	3,327,061	30,632	46,437	+ 39.3	+ 51.6
Face, paving, sewer brick No.	910,618	564,788	25,821	19,613	— 38.0	— 24.0
Firebrick, blocks			77,404	115,121		+ 32.8
Fireclay tons	523	567	7,137	7,657	+ 8.4	+ 7.3
Structural tile—hollow blocks			14,766	33,444		+126.5
Drain-tile, sewer-pipe No.	668,907	712,745	49,328	54,179	+ 6.6	+ 9.8
Pottery—glazed or unglazed			3,508	2,875		— 18.0
Bentonite; other clay products			4,040	1,961		— 51.5
Totals			212,636	281,287		+ 32.3
Other Structural Materials.						
Cement			314,115	516,931		+ 64.6
Lime and limestone tons	82,902	72,591	133,286	137,158	— 11.2	+ 3.0
Sand and gravel			362,996	477,397		+ 31.7
Stone—building, grindstones tons	4,640	5,890	95,152	175,226	+ 26.9	+ 84.2
Rubble, riprap, crushed rock tons	173,353	333,348	120,532	208,178	+ 92.0	+ 64.4
Totals			1,026,081	1,515,390		+ 47.7
Total value in Canadian funds			48,821,239	54,081,967		+ 10.8

* Canadian funds.

† Sulphur content of pyrites shipped, estimated sulphur contained in sulphuric acid made from waste smelter-gases, and elemental sulphur.

TABLE II.—AVERAGE METAL PRICES USED IN COMPILING VALUE OF PROVINCIAL PRODUCTION OF GOLD, SILVER, COPPER, LEAD, AND ZINC.

Year.	Gold, Fine Ounce.	Silver, Fine Ounce.	Copper, Lb.	Lead, Lb.	Zinc, Lb.
	$	Cents.	Cents.	Cents.	Cents.
1901	20.67	56.002 N.Y.	16.11 N.Y.	3.897 N.Y.	.....
1902	.....	49.55 ,,	11.70 ,,	3.66 ,,	.....
1903	.....	50.78 ,,	13.24 ,,	3.81 ,,	.....
1904	.....	53.36 ,,	12.82 ,,	3.88 ,,	.....
1905	.....	51.33 ,,	15.59 ,,	4.24 ,,	.....
1906	.....	63.45 ,,	19.28 ,,	4.81 ,,	.....
1907	.....	62.06 ,,	20.00 ,,	4.80 ,,	.....
1908	.....	50.22 ,,	13.20 ,,	3.78 ,,	.....
1909	.....	48.93 ,,	12.98 ,,	3.85 ,,	.....
1910	.....	50.812 ,,	12.738 ,,	4.00 ,,	4.60 E. St. L.
1911	.....	50.64 ,,	12.38 ,,	3.98 ,,	4.90 ,,
1912	.....	57.79 ,,	16.341 ,,	4.024 ,,	5.90 ,,
1913	.....	56.80 ,,	15.27 ,,	3.93 ,,	4.80 ,,
1914	.....	52.10 ,,	13.60 ,,	3.50 ,,	4.40 ,,
1915	.....	47.20 ,,	17.28 ,,	4.17 ,,	11.25 ,,
1916	.....	62.38 ,,	27.202 ,,	6.172 ,,	10.88 ,,
1917	.....	77.35 ,,	27.18 ,,	7.91 ,,	7.566 ,,
1918	.....	91.93 ,,	24.53 ,,	6.67 ,,	6.94 ,,
1919	.....	105.57 ,,	18.70 ,,	5.19 ,,	6.24 ,,
1920	.....	95.80 ,,	17.45 ,,	7.16 ,,	6.52 ,,
1921	.....	59.52 ,,	12.50 ,,	4.09 ,,	3.95 ,,
1922	.....	64.14 ,,	13.38 ,,	5.16 ,,	4.86 ,,
1923	.....	61.63 ,,	14.42 ,,	6.54 ,,	5.62 ,,
1924	.....	63.442 ,,	13.02 ,,	7.287 ,,	5.39 ,,
1925	.....	69.065 ,,	14.042 ,,	7.848 Lond.	7.892 Lond.
1926	.....	62.107 ,,	13.795 ,,	6.751 ,,	7.409 ,,
1927	.....	56.37 ,,	12.92 ,,	5.256 ,,	6.194 ,,
1928	.....	58.176 ,,	14.570 ,,	4.575 ,,	5.493 ,,
1929	.....	52.993 ,,	18.107 ,,	5.050 ,,	5.385 ,,
1930	.....	38.154 ,,	12.982 ,,	3.927 ,,	3.599 ,,
1931	.....	28.700 ,,	8.116 ,,	2.710 ,,	2.554 ,,
1932	23.47	31.671 ,,	6.380 Lond.	2.113 ,,	2.405 ,,
1933	28.60	37.832 ,,	7.454 ,,	2.391 ,,	3.210 ,,
1934	34.50	47.461 ,,	7.419 ,,	2.436 ,,	3.044 ,,
1935	35.19	64.790 ,,	7.795 ,,	3.133 ,,	3.099 ,,
1936	**35.03**	**45.127** ,,	**9.477** ,,	**3.913** ,,	**3.315** ,,
Average 1932–36 (inclusive)	31.36	45.576 ,,	7.705 ,,	2.797 ,,	3.014 ,,

NOTE.—In making comparisons with average prices used prior to 1926, it should be remembered that deductions were made from the average prices as a means of adjustment between the "assay value content" of ores shipped instead of allowing percentage losses in smelting operations. The price of copper prior to 1926 was taken at "net"; silver, at 95 per cent.; lead, at 90 per cent.; and zinc, at 85 per cent. Subsequent to 1926 (inclusive) prices are true averages, and adjustments are made on the metal content of ores for loss in smelting and refining.

TABLE III.—TOTAL PRODUCTION FOR ALL YEARS UP TO AND INCLUDING 1936.

Gold, placer	$82,702,699*
Gold, lode	191,813,716*
Silver	123,951,149
Copper	286,080,205
Lead	216,272,482
Zinc	127,849,893
Coal and coke	366,373,157
Structural materials	72,867,552
Miscellaneous minerals, etc.	11,433,756
Total	$1,479,344,609

* Canadian funds.

TABLE IV.—PRODUCTION FOR EACH YEAR FROM 1852 TO 1936 (INCLUSIVE).

1852 to 1895 (inclusive)	$94,547,241	1917	$37,010,392
1896	7,507,956	1918	41,782,474
1897	10,455,268	1919	33,296,313
1898	10,906,861	1920	35,543,084
1899	12,393,131	1921	28,066,641
1900	16,344,751	1922	35,162,843
1901	20,086,780	1923	41,304,320
1902	17,486,550	1924	48,704,604
1903	17,495,954	1925	61,492,242
1904	18,977,359	1926	67,188,842
1905	22,461,325	1927	60,729,358
1906	24,980,546	1928	65,372,583
1907	25,882,560	1929	68,245,443
1908	23,851,277	1930	55,391,993
1909	24,443,025	1931	34,883,181
1910	26,377,066	1932	*28,798,406
1911	23,499,072	1933	*32,602,672
1912	32,440,800	1934	*42,305,297
1913	30,296,398	1935	*48,821,239
1914	26,388,825	1936	*54,081,967
1915	29,447,508		
1916	42,290,462	Total	$1,479,344,609

* Canadian funds.

TABLE V.—QUANTITIES AND VALUE OF MINE PRODUCTS FOR 1934, 1935, AND 1936.

Description.	1934.		1935.		1936.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold, placer* oz.	25,181	$714,431	30,929	$895,058	43,389	$1,249,940
Gold, lode* oz.	297,130	10,250,985	365,244	12,852,936	404,472	14,168,654
Silver oz.	8,572,916	4,068,792	9,251,544	5,994,075	9,521,015	4,296,548
Copper lb.	48,084,658	3,567,401	38,791,127	3,023,768	20,806,672	1,971,848
Lead lb.	347,366,967	8,461,859	344,268,444	10,785,930	377,971,618	14,790,029
Zinc lb.	247,926,844	7,546,893	256,239,446	7,940,860	254,581,393	8,439,373
Coal tons, 2,240 lb.	1,347,090	5,725,133	1,187,968	5,048,864	1,346,471	5,722,502
Structural materials		1,017,141		1,238,717		1,796,677
Miscellaneous metals and minerals		952,662		1,041,031		1,646,396
Totals		$42,305,297		$48,821,239		$54,081,967

* Canadian funds.

TABLE VI.—Production of Lode Gold, Silver, Copper, Lead, and Zinc.

Year.	Gold.		Silver.		Copper.		Lead.		Zinc.		Total Value.
	Oz.	Value.	Oz.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	
		$		$		$		$		$	$
1887			17,690	17,331			204,800	9,216			26,547
1888			79,780	75,000			674,500	29,813			104,813
1889			53,192	47,873			165,100	6,498			54,371
1890			70,427	73,948							73,948
1891			4,500	4,000							4,000
1892			77,160	66,935			808,420	33,064			99,999
1893	1,170	23,404	227,000	195,000			2,135,023	78,996			297,400
1894	6,252	125,014	746,379	470,219	324,680	16,234	5,662,523	169,875			781,342
1895	39,264	785,271	1,496,522	977,229	952,840	47,642	16,475,464	532,255			2,342,397
1896	62,259	1,244,180	3,135,343	2,100,689	3,818,556	190,926	24,199,977	721,384			4,257,179
1897	106,141	2,122,820	5,472,971	3,272,836	5,325,180	266,258	38,841,135	1,390,517			7,052,431
1898	110,061	2,201,217	4,292,401	2,375,841	7,271,678	874,781	31,693,559	1,077,581			6,529,420
1899	138,315	2,857,573	2,939,413	1,663,708	7,722,591	1,351,453	21,862,436	878,870			6,751,604
1900	167,153	3,453,381	3,958,175	2,309,200	9,997,080	1,615,289	63,358,621	2,691,887			10,069,757
1901	210,384	4,348,603	5,151,333	2,884,745	27,603,746	4,446,963	51,582,906	2,002,733			13,683,044
1902	236,491	4,888,269	3,917,917	1,941,328	29,636,057	3,446,673	22,536,581	824,832			11,101,102
1903	232,831	4,812,616	2,996,204	1,521,472	34,359,921	4,547,535	18,089,283	689,744			11,571,367
1904	222,042	4,589,608	3,222,481	1,719,516	35,710,128	4,578,037	36,646,244	1,421,874			12,309,035
1905	238,660	4,933,102	3,439,417	1,971,818	37,692,251	5,876,222	56,580,703	2,399,022			15,180,164
1906	224,027	4,630,639	2,990,262	1,897,320	42,990,488	8,288,565	52,408,217	2,667,578			17,484,102
1907	196,179	4,055,020	2,745,448	1,703,825	40,832,720	8,166,544	47,738,703	2,291,458			16,216,847
1908	255,582	5,282,880	2,631,389	1,321,483	47,274,614	6,240,249	43,195,733	1,632,799			14,477,411
1909	238,224	4,924,090	2,532,742	1,239,270	45,597,245	5,918,522	44,396,346	1,709,259	8,500,000	400,000	14,191,141
1910	267,701	5,533,380	2,450,241	1,245,016	38,243,934	4,871,512	34,658,746	1,386,350	4,184,192	192,473	13,228,731
1911	228,617	4,725,513	1,892,364	958,293	36,927,656	4,571,644	26,872,397	1,069,521	2,634,544	129,092	11,454,063
1912	257,496	5,322,442	3,132,108	1,810,045	51,456,537	8,408,513	44,871,454	1,805,627	5,358,280	316,139	17,662,766
1913	272,254	5,627,490	3,465,856	1,968,606	46,460,305	7,094,489	55,364,677	2,175,832	6,758,768	324,421	17,190,838
1914	247,170	5,109,004	3,602,180	1,876,736	45,009,699	6,121,319	50,625,048	1,771,877	7,866,467	346,125	15,225,061
1915	250,021	5,167,934	3,366,506	1,588,991	56,918,405	9,835,500	46,503,590	1,939,200	12,982,440	1,460,524	19,992,149
1916	221,932	4,587,334	3,301,923	2,059,739	65,379,364	17,784,494	48,727,516	3,007,462	37,168,980	4,043,985	31,483,014
1917	114,523	2,367,190	2,929,216	2,265,749	59,007,565	16,038,256	37,307,465	2,951,020	41,848,513	3,166,259	26,788,474
1918	164,674	3,403,812	3,498,172	3,215,870	61,483,754	15,143,449	43,899,661	2,928,107	41,772,916	2,899,040	27,590,278
1919	152,426	3,150,645	3,403,119	3,592,673	42,459,339	7,939,896	29,475,968	1,526,855	56,737,651	3,540,429	19,750,498
1920	120,048	2,481,392	3,377,849	3,235,980	44,887,676	7,832,899	39,331,218	2,816,115	47,208,268	3,077,979	19,444,365
1921	135,663	2,804,154	2,673,389	1,591,201	39,036,993	4,879,624	41,402,288	1,693,354	49,419,372	1,952,065	12,920,398
1922	197,856	4,089,684	7,101,311	4,554,781	32,359,896	4,329,754	67,447,985	3,480,316	57,146,548	2,777,322	19,231,857
1923	179,245	3,704,994	6,032,986	3,718,129	57,720,290	8,323,266	96,663,152	6,321,770	58,343,462	3,278,903	25,347,062
1924	247,716	5,120,535	8,341,768	5,292,184	64,845,393	8,442,870	170,384,481	12,415,917	79,130,970	4,266,741	35,538,247
1925	209,719	4,335,269	7,654,844	5,286,818	72,306,432	10,153,269	237,899,199	18,670,329	98,257,099	7,754,450	46,200,135
1926	201,427	4,163,859	10,748,556	6,675,606	89,339,768	12,324,421	263,023,937	17,757,535	142,876,947	10,586,610	51,508,031
1927	178,001	3,679,601	10,479,185	5,902,043	89,202,871	11,525,011	282,996,423	14,874,292	145,225,443	8,996,135	44,977,082
1928	188,087	3,888,097	10,627,167	6,182,461	97,908,316	14,265,242	305,140,792	13,961,412	181,763,147	9,984,613	48,281,825
1929	145,339	3,004,419	9,918,800	5,256,270	101,483,857	18,375,682	302,346,268	15,269,696	172,096,841	9,268,792	51,174,859
1930	160,778	3,323,576	11,289,171	4,307,270	90,421,545	11,738,525	319,199,752	12,535,931	207,287,306	9,010,093	40,915,395
1931	146,039	3,018,894	7,524,320	2,247,514	63,194,299	5,289,363	248,783,508	6,742,282	205,071,247	5,237,520	22,535,573
1932	181,564	4,251,307*	7,130,838	2,258,453	49,841,009	3,179,956	254,488,952	5,378,878	192,120,091	4,621,641	19,700,235
1933	223,529	6,392,929*	7,006,406	2,650,720	42,608,002	3,176,341	271,606,071	6,495,731	195,963,751	6,291,416	25,007,137
1934	297,130	10,250,985*	8,572,916	4,068,792	48,084,658	3,567,401	347,366,967	8,461,859	247,926,844	7,546,893	33,895,930
1935	365,244	12,852,936*	9,251,544	5,994,075	38,791,127	3,023,768	344,268,444	10,785,930	256,239,446	7,940,860	40,597,569
1936	404,472	14,168,654	9,521,015	4,296,548	20,806,672	1,971,848	377,971,618	14,790,029	254,581,393	8,439,373	43,666,452
Totals	8,443,706	191,813,716	220,482,896	123,951,149	1,923,294,127	286,080,205	4,967,897,651	216,272,482	2,861,470,926	127,849,893	945,967,445

* Canadian funds.

TABLE VII.—Value of Gold Production to Date.

Year.	Placer.	Lode.	Total.
1858–1862	$9,871,634		$9,871,634
1863–1867	16,283,592		16,283,592
1868–1872	9,895,318		9,895,318
1873–1877	9,019,201		9,019,201
1878–1882	5,579,911		5,579,911
1883–1887	3,841,515		3,841,515
1888–1892	2,525,426		2,525,426
1893	356,131	$23,404	379,535
1894	405,516	125,014	530,530
1895	481,683	785,271	1,266,954
1896	544,026	1,244,180	1,788,206
1897	513,520	2,122,820	2,636,340
1898	643,346	2,201,217	2,844,563
1899	1,344,900	2,857,573	4,202,473
1900	1,278,724	3,453,381	4,732,105
1901	970,100	4,348,603	5,318,703
1902	1,073,140	4,888,269	5,961,409
1903	1,060,420	4,812,616	5,873,036
1904	1,115,300	4,589,608	5,704,908
1905	969,300	4,933,102	5,902,402
1906	948,400	4,630,639	5,579,039
1907	828,000	4,055,020	4,883,020
1908	647,000	5,282,880	5,929,880
1909	477,000	4,924,090	5,401,090
1910	540,000	5,533,380	6,073,380
1911	426,000	4,725,513	5,151,513
1912	555,500	5,322,442	5,877,942
1913	510,000	5,627,490	6,137,490
1914	565,000	5,109,004	5,674,004
1915	770,000	5,167,934	5,937,934
1916	580,500	4,587,334	5,167,834
1917	496,000	2,367,190	2,863,190
1918	320,000	3,403,812	3,723,812
1919	286,500	3,150,645	3,437,145
1920	221,600	2,481,392	2,702,992
1921	233,200	2,804,154	3,037,354
1922	368,800	4,089,684	4,458,484
1923	420,000	3,704,994	4,124,994
1924	420,750	5,120,535	5,541,285
1925	280,092	4,335,269	4,615,361
1926	355,503	4,163,859	4,519,362
1927	156,347	3,679,601	3,835,848
1928	143,208	3,888,097	4,031,305
1929	118,711	3,004,419	3,123,130
1930	152,235	3,323,576	3,475,811
1931	291,992	3,018,894	3,310,886
1932	395,542	4,261,307	4,656,849*
1933	562,787	6,392,929	6,955,716*
1934	714,431	10,250,985	10,965,416*
1935	895,058	12,852,936	13,747,994*
1936	1,249,940	14,168,654	15,418,594*
Totals	$82,702,699	$191,813,716	$274,516,415

* Canadian funds.

TABLE VIII.—Output of Mine Products by Districts and Divisions, 1932, 1933, 1934, 1935, and 1936.

Names.	Divisions.					Districts.				
	1932.	1933.	1934.	1935.	1936.	1932.	1933.	1934.	1935.	1936.
North-western District (No. 1)						$5,138,528	$5,097,666	$5,239,054	$4,543,389	$2,904,200
Atlin, Stikine, and Liard	$173,460	$279,402	$307,313	$406,378	$549,047					
Nass River	2,610,225	2,878,808	3,088,657	2,221,212	61,834					
Portland Canal	2,311,511	1,841,862	1,700,734	1,636,954	2,053,210					
Skeena, Queen Charlotte, and Bella Coola	43,332	97,594	142,360	278,845	240,109					
North-eastern District (No. 2)						206,733	474,293	780,122	1,717,546	1,998,344
Cariboo and Quesnel	166,151	418,378	690,386	1,618,191	1,867,539					
Omineca and Peace River	40,582	55,915	89,736	99,355	130,805					
Central District (No. 3)						291,719	243,863	619,036	564,441	632,040
Nicola and Vernon	120,813	133,146	214,798	315,550	194,490					
Yale, Ashcroft, and Kamloops	158,204	104,776	404,238	248,891	437,550					
Clinton*	12,702	5,941								
Southern District (No. 4)						1,577,412	1,085,336	1,207,845	2,330,201	2,689,497
Grand Forks, Greenwood, and Osoyoos	818,990	450,514	694,414	1,799,685	2,118,630					
Similkameen	758,422	634,822	513,431	530,516	570,867					
Eastern District (No. 5)						14,522,464	17,875,958	24,828,234	28,994,311	33,258,173
Fort Steele	13,835,476	15,955,987	20,042,528	23,067,831	27,089,325					
Windermere and Golden	18,338	424,939	1,360,312	530,863	12,513					
Ainsworth	21,831	21,413	48,246	215,104	55,962					
Slocan and Slocan City	9,948	30,296	84,719	406,133	194,696					
Nelson and Arrow Lake	294,439	759,537	1,496,843	1,991,723	3,051,401					
Trail Creek	307,537	669,017	1,786,961	2,582,959	2,742,916					
Revelstoke and Lardeau	84,895	14,769	8,625	199,698	111,460					
Western District (No. 6)						7,061,550	7,825,556	9,631,006	10,671,351	12,599,713
Nanaimo, Alberni, Clayoquot, Quatsino, and Victoria	4,015,841	3,043,331	2,965,047	3,262,171	3,881,722					
Vancouver, New Westminster, and Lillooet	3,045,709	4,782,225	6,466,377	7,172,367	8,303,079					
Yale, Ashcroft, and Clinton			199,582	236,813	414,912					
Totals†	$28,798,406	$32,602,672	$42,305,297	$48,821,239	$54,081,967	$28,798,406	$32,602,672	$42,305,297	$48,821,239	$54,081,967

* Yale, Ashcroft, and Clinton Mining Divisions included in No. 6 District (Mainland section) from and including 1934. † Canadian funds.

TABLE IX.—PRODUCTION IN DETAIL OF PLACER GOLD, LODE

DISTRICTS AND DIVISIONS.	YEAR.	TONS.	GOLD—PLACER.		GOLD—LODE.		SILVER.	
			Ounces.	Value.	Ounces.	Value.	Ounces.	Value.
				$		$		$
North-western District (No. 1)								
Atlin	1935		13,227	382,797				
	1936	**6**	**18,423**	**530,726**	**2**	**70**	**934**	**421**
Stikine	1935		363	10,522				
	1936		**216**	**6,222**				
Liard	1935		285	8,234				
	1936		**228**	**6,568**				
Nass River	1935	1,210,308			5,367	195,903	257,081	166,563
	1936	**6,645**			**221**	**7,742**	**24,997**	**11,280**
Portland Canal	1935	156,855			33,611	1,182,771	674,201	436,815
	1936	**197,247**			**44,188**	**1,547,906**	**1,044,049**	**471,148**
Skeena	1935	12,262	102	2,956	6,632	233,380	1,476	956
	1936	**19,327**	**26**	**749**	**4,844**	**169,685**	**1,433**	**647**
Queen Charlotte	1935		122	3,519				
	1936	**5,096**	**65**	**1,872**	**20**	**700**	**7**	**3**
Bella Coola	1935							
	1936							
North-eastern District (No. 2)								
Cariboo	1935	73,758	6,280	181,721	35,835	1,261,034	4,555	2,951
	1936	**95,409**	**11,980**	**345,117**	**36,765**	**1,287,878**	**4,657**	**2,102**
Quesnel	1935		4,948	113,188				
	1936		**7,211**	**207,733**				
Omineca	1935	1,072	1,629	47,155	261	9,184	2,622	1,699
	1936	**10**	**1,775**	**51,134**	**7**	**245**	**3,205**	**1,446**
Peace River	1935		294	8,516				
	1936		**332**	**9,564**				
Central District (No. 3)								
Nicola	1935	7,844	1	35	874	30,756	25,224	16,342
	1936	**18,889**			**1,086**	**38,043**	**28,411**	**12,821**
Vernon	1935	1,843	38	1,091	301	10,592	304	197
	1936	**41**	**110**	**3,169**	**48**	**1,681**	**361**	**163**
Kamloops	1935	17,757	222	6,440	6,401	225,251	18,541	12,013
	1936	**18,343**	**166**	**4,782**	**7,021**	**245,946**	**19,405**	**8,757**
Southern District (No. 4)								
Grand Forks	1935	15,635	25	739	1,731	60,914	46,149	29,900
	1936	**494**	**9**	**259**	**1,061**	**37,167**	**18,361**	**8,286**
Greenwood	1935	42,252	257	7,425	13,130	462,015	733,143	487,961
	1936	**22,957**	**135**	**3,889**	**5,905**	**206,852**	**728,047**	**328,546**
Osoyoos	1935	69,328			18,934	666,287	2,520	1,633
	1936	**115,190**	**2**	**58**	**39,555**	**1,385,612**	**28,981**	**13,078**
Similkameen	1935		179	5,173				
	1936	**8**	**102**	**2,938**	**4**	**140**	**2**	**1**
Eastern District (No. 5)								
Fort Steele	1935	1,861,295	640	18,510			6,673,000	4,323,437
	1936	**1,901,477**	**657**	**18,927**			**7,068,195**	**3,189,664**
Windermere	1935		11	317				
	1936		**15**	**432**				
Golden	1935	55,918	11	317			45,540	29,505
	1936		**4**	**115**				
Ainsworth	1935	13,337	57	1,654	11	387	106,808	69,201
	1936	**766**	**2**	**58**	**1**	**35**	**21,056**	**9,502**
Slocan	1935	33,081			78	2,745	404,316	261,956
	1936	**11,677**	**1**	**29**	**54**	**1,892**	**226,661**	**102,285**
Slocan City	1935	117	4	105	39	1,372	4,475	2,899
	1936	**37**			**63**	**2,207**	**509**	**230**
Nelson	1935	142,428	132	3,835	53,262	1,874,290	67,635	43,821
	1936	**209,927**	**160**	**4,609**	**81,614**	**2,858,938**	**121,111**	**54,654**
Arrow Lake	1935		15	458				
	1936		**2**	**58**				
Trail Creek*	1935	37,553	59	1,689	23,576	829,639	28,656	18,566
	1936	**15,823**	**151**	**4,350**	**10,415**	**364,837**	**10,627**	**4,796**
Revelstoke	1935		83	2,393				
	1936	**102**	**79**	**2,276**	**6**	**210**	**6,742**	**3,042**
Lardeau	1935	28,823	89	2,569	5,403	190,132	3,451	2,236
	1936	**102,872**	**29**	**835**	**2,749**	**96,298**	**1,416**	**639**
Western District (No. 6)								
Nanaimo	1935	47	3	71	44	1,548	138	89
	1936	**270**	**3**	**86**	**61**	**2,137**	**209**	**94**
Alberni	1935	90	6	176	168	5,912	78	51
	1936	**207**			**53**	**1,856**	**6**	**3**
Clayoquot	1935	74			231	8,129	134	87
	1936	**33**			**311**	**10,894**	**112**	**50**
Quatsino	1935		34	985				
	1936							
Victoria	1935		9	246				
	1936		**37**	**1,066**				
Lillooet	1935	304,024	740	21,431	140,044	4,928,148	44,312	28,710
	1936	**385,546**	**618**	**17,803**	**145,505**	**5,097,040**	**53,939**	**24,341**
Clinton	1935	5,800	322	9,325	851	29,947	1,360	881
	1936	**12,352**	**322**	**9,276**	**8,553**	**299,612**	**13,038**	**5,884**
Ashcroft	1935	7,052	445	12,879	4,278	150,543	7,489	1,852
	1936		**278**	**8,009**				
Yale	1935	259	83	2,393	68	2,393	7	5
	1936	**1,161**	**54**	**1,556**	**163**	**5,710**	**3,722**	**1,680**
New Westminster	1935		214	6,194				
	1936		**84**	**2,420**				
Vancouver	1935	817,807			13,914	489,634	78,329	50,749
	1936	**1,314,609**	**113**	**3,255**	**14,197**	**497,321**	**90,822**	**40,985**
Totals	1935	4,916,149	30,929	†895,058	365,244	12,852,936	9,251,544	5,994,075
	1936	**4,456,521**	**43,389**	**1,249,940**	**404,472**	**14,168,654**	**9,521,015**	**4,296,548**

* Includes zinc and lead recovered from slag and reclaimed slags which cannot be credited to individual mines.

† Includes placer gold purchased by Gold Commissioners from "snipers" and others, who in many instances located in another division. In most cases the gold is credited to the mining division in which it was sold, this

GOLD, SILVER, COPPER, LEAD, AND ZINC IN 1935 AND 1936.

COPPER.		LEAD.		ZINC.		TOTALS FOR DIVISIONS.		TOTALS FOR DISTRICTS.
Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	1935.	1936.	1936.
	$		$		$	$	$	$
								2,833,186
						382,797		
		1,139	45				531,262	
						10,522		
							6,222	
						8,234		
							6,568	
23,558,968	1,836,422					2,198,888		
450,615	42,705	2,751	107				61,834	
35,401	2,759	466,233	14,607	69	2	1,636,954		
873	82	864,074	33,811				2,052,947	
10,420	812					238,104		
7,354	697						171,778	
						3,519		
							2,575	
								1,905,281
		54	2	451	14	1,445,722		
		163	6				1,635,103	
						143,188		
							207,733	
		8,173	256	1,261	39	58,333		
		600	24	954	32		52,881	
						8,516		
							9,564	
								340,314
		230,395	7,218	58,324	1,808	56,159		
24,908	2,361	353,813	13,845	106,177	3,520		70,590	
		388	12	238	7	11,899		
		431	17	228	8		5,038	
38,448	2,997	38,869	1,218	31,364	972	248,891		
31,803	3,014	34,330	1,343	25,475	844		264,686	
								2,077,169
		15,938	499	20,671	641	92,693		
		1,078	42	10,731	356		46,110	
		680,369	21,316	614,337	19,038	997,785		
158,164	14,989	567,444	22,204	693,859	23,001		599,481	
2,334	182	9,759	306	3,549	110	668,518		
307,229	29,116	15,407	603	967	32		1,428,499	
						5,173		
							3,079	
								29,840,075
		330,000,000	10,338,900	213,400,000	6,613,266	21,294,113		
		360,362,863	14,100,999	232,818,066	7,717,919		25,027,509	
						317		
							432	
		6,267,392	196,358	9,435,300	292,100	518,580		
							115	
		2,070,291	64,862	1,950,610	60,450	196,554		
		814,475	31,870	7,065	234		41,699	
		2,832,099	88,730	1,544,259	47,856	401,287		
		1,408,291	55,106	993,479	32,934		192,246	
		9,124	286	5,944	184	4,846		
		244	10	90	3		2,450	
17,471	1,362	873,856	27,362	527,016	16,332	1,967,002		
6,130	581	1,709,355	66,887	1,043,278	34,584		3,020,253	
						458		
							58	
967,707	75,433	5,979	187	25,550,184	791,800	1,717,314		
311,600	29,530	11,242,020	439,900	18,256,826	605,214		1,448,627	
						2,393		
		86,519	3,386				8,914	
155	12	2,841	89			195,038		
							97,772	
								7,920,367
656	51					1,759		
961	91						2,408	
		263	8			6,117		
							1,859	
243	19					8,235		
		164	6				10,950	
						985		
						246		
							1,066	
		14,571	456			4,978,745		
		26,105	1,022				5,140,206	
6,013	468	60	2			40,623		
27,672	2,623	133	5				317,400	
5,847	156					168,730		
							8,009	
						4,791		
		7,986	313				9,259	
						6,194		
							2,420	
14,147,464	1,102,795	742,290	23,256	3,095,876	95,941	1,762,375		
19,479,363	1,846,059	472,233	18,478	624,198	20,692		2,426,790	
38,791,127	3,023,768	314,268,444	10,785,930	256,239,446	7,940,860	41,492,627		
20,806,672	1,971,848	377,971,618	14,790,029	254,581,393	8,439,373		44,916,392	44,916,392

obtained the gold in one mining division, but did not sell the gold until reaching the Gold Commissioner's office applying particularly to Vancouver and Victoria Mining Divisions.

TABLE IX.A.—PRODUCTION IN DETAIL OF PLACER GOLD, LODE

DISTRICTS AND DIVISIONS.	YEAR.	TONS.	GOLD—PLACER.		GOLD—LODE.		SILVER.	
			Ounces.	*Value.*	*Ounces.*	*Value.*	*Ounces.*	*Value.*
				$		$		$
North-western District (No. 1)								
Atlin	1932	30	8,040	155,684	218	5,117	86	27
	1933	30	11,299	265,751	103	2,946	64	24
Stikine	1932		37	727				
	1933		251	5,891				
Liard	1932		357	6,877				
	1933		200	4,690				
Nass River	1932	1,740,300			3,323	77,991	255,940	81,061
	1933	1,540,187			4,382	125,325	257,854	97,553
Portland Canal	1932	221,828			76,049	1,784,870	1,580,305	500,508
	1933	187,164			50,089	1,432,545	1,029,606	389,529
Skeena	1932	6	36	704	3	70	2	1
	1933	1,629	76	1,802	1,298	37,123	357	135
Queen Charlotte	1932		18	352				
	1933	400	65	1,516	53	1,516	25	10
Bella Coola	1932		3	47				
	1933		2	57				
North-eastern District (No. 2)								
Cariboo	1932		4,155	80,697				
	1933	19,769	4,897	115,172	7,660	219,076	823	311
Quesnel	1932		3,338	64,925				
	1933		2,772	65,179				
Omineca	1932	8	627	12,157	7	164	3	1
	1933	26	699	16,445	82	2,345	15	6
Peace River	1932		588	11,376				
	1933		300	7,064				
Central District (No. 3)								
Nicola	1932							
	1933	9			34	972	1,053	398
Vernon	1932		55	1,056				
	1933	390	63	1,487	119	3,403	18	7
Kamloops	1932		83	1,619				
	1933	43	249	5,863	194	5,549		
Southern District (No. 4)								
Grand Forks	1932	26,456			19,218	451,046	131,713	41,716
	1933	3,720			3,144	89,919	3,605	1,137
Greenwood	1932	3,412	180	3,474	414	9,717	595,470	188,595
	1933	3,627	250	5,891	427	12,212	558,472	211,286
Osoyoos	1932	386	2	47	1,367	32,084	203	64
	1933	2,605			1,799	51,451	2,695	1,020
Similkameen	1932	529	270	5,210	1	23	14,461	4,580
	1933		300	7,093				
Eastern District (No. 5)								
Fort Steele	1932	1,440,520	543	10,591			4,418,852	1,399,523
	1933	1,401,101	652	15,329	12	343	4,921,950	1,862,112
Windermere	1932							
	1933		35	829				
Golden	1932		6	117				
	1933	35,612	11	257			53,846	20,371
Ainsworth	1932	43	28	540	2	47	8,168	2,587
	1933		32	743				
Slocan	1932	218			6	141	18,845	5,968
	1933	783			12	343	47,240	17,872
Slocan City	1932	30			17	399	1,370	434
	1933	23			19	543	638	241
Nelson	1932	13,740	153	2,957	9,631	226,039	33,535	10,621
	1933	44,051	152	3,575	23,289	666,066	48,334	18,286
Arrow Lake	1932		4	71				
	1933		7	172				
Trail Creek	1932	565	7	141	1,489	34,947	641	203
	1933	11,960	71	1,659	9,313	266,352	12,273	4,643
Revelstoke	1932		908	17,632				
	1933		281	6,607				
Lardeau	1932	13	76	1,455	13	305		
	1933	1	50	1,173	2	57	2	1
Western District (No. 6)								
Nanaimo	1932	2			8	188	7	2
	1933	2	4	86	2	57	7	3
Alberni	1932		1	23				
	1933		25	600				
Clayoquot	1932	8	18	352	13	305	28	9
	1933	29	15	343	49	1,401	31	12
Quatsino	1932							
	1933							
Victoria	1932		2	47				
	1933		6	143				
Lillooet	1932	82,657	293	5,633	60,540	1,420,874	11,778	3,730
	1933	154,212	407	9,581	108,298	3,097,323	24,668	9,333
Clinton	1932	25	199	3,849	28	657		
	1933		225	5,291				
Ashcroft	1932		128	2,464				
	1933	657	320	7,522	330	9,438	638	241
Yale	1932	148	224	4,319	344	8,074	79	25
	1933		105	2,459				
New Westminster	1932		21	399				
	1933		107	2,517				
Vancouver	1932	809,264			8,873	208,249	59,352	18,798
	1933	622,718			12,819	366,624	42,792	16,189
Totals	1932	4,340,158	20,400	395,542	181,564	4,261,307	7,130,838	2,258,453
	1933	4,030,778	23,928	562,787	223,529	6,392,929	7,006,406	2,650,720

NOTE.—The above table is published to serve as a record to show gold (fine ounces) valued at average prices for 1932 and was $28.60. In the Annual Reports for 1932 and 1933 the old standard price was used and should be noted when reference

GOLD, SILVER, COPPER, LEAD, AND ZINC IN 1932 AND 1933.

COPPER.		LEAD.		ZINC.		TOTALS FOR DIVISIONS.		TOTALS FOR DISTRICTS.
Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	1932.	1933.	1933.
	$		$		$	$	$	$
								4,951,883
						160,828		
							268,721	
						727		
							5,891	
						6,877		
							4,690	
38,293,437	2,443,198					2,602,250		
34,416,459	2,565,678						2,788,556	
35,933	2,293	1,127,932	23,840			2,311,511		
29,749	2,218	731,435	17,493	2,400	77		1,841,862	
						775		
53	4						39,064	
						352		
							3,042	
						47		
							57	
								425,598
						80,697		
							334,559	
						64,925		
							65,179	
						12,322		
							18,796	
						11,376		
							7,064	
								17,967
		7,762	186	1,206	39		1,595	
						1,056		
							4,897	
						1,619		
848	63						11,475	
								406,404
13,402	855	198,955	4,205	402,479	9,682	507,504		
		7,215	172	16,498	529		91,757	
1,349	86	303,950	6,424	462,026	11,129	219,425		
		381,175	9,116	516,262	16,575		255,080	
		131,581	2,781			34,976		
		112	3				52,474	
				22,458	540	10,358		
							7,093	
								15,376,907
		251,308,444	5,311,655	190,427,427	4,580,922	11,302,691		
		260,369,484	6,226,996	180,116,639	5,782,645		13,887,425	
							829	
						117		
		8,108,250	193,917	6,270,700	201,321		415,866	
		20,949	443	8,661	209	3,826		
							743	
		116,146	2,455	22,892	551	9,115		
		329,095	7,871	106,716	3,426		29,512	
						833		
							784	
		616,145	13,023	773,548	18,608	271,248		
		698,904	16,715	987,070	31,689		736,331	
						71		
							172	
						35,291		
331,514	24,713	486	12	825	27		297,406	
						17,632		
							6,607	
						1,760		
		46	1				1,232	
								4,391,165
						190		
							146	
						23		
							600	
						666		
							1,756	
						47		
							143	
						1,430,237		
							3,116,237	
						4,506		
							5,291	
						2,464		
158	12						17,213	
						12,418		
							2,459	
						399		
							2,517	
11,496,888	733,524	664,850	14,052			974,623		
7,829,221	583,653	972,107	23,249	7,945,435	255,088		1,244,803	
49,841,009	3,179,956	254,488,952	5,378,878	192,120,091	4,621,641	20,095,777		
42,608,002	3,176,341	271,606,071	6,495,731	195,963,751	6,291,416		25,569,924	25,569,924

1933, as distinct from the old standard price of $20.671834. The price of a fine ounce of gold in 1932 was $23.47 and in 1933 to value is contemplated.

TABLE X.—Production in Detail of Structural Materials, 1936.

District and Division.	Cement.	Lime and Limestone.	Building-stone.	Riprap and Crushed Rock.	Sand and Gravel.	Brick (Common).	Face, Paving, and Sewer Brick.	Firebrick, Blocks.	Fireclay.	Structural Tile, Hollow.	Drain-tile and Sewer-pipe.	Pottery, Glazed or Unglazed.	Other Clay Products.	Divisions.	Districts.
	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
North-western District (No. 1)															71,014
Atlin, Liard, and Stikine				300	4,695									4,995	
Nass River															
Portland Canal					263									263	
Skeena and Queen Charlotte				9,362	35,146									44,508	
Bella Coola		10,570		2,822	7,856									21,248	
North-eastern District (No. 2)															70,124
Cariboo and Quesnel				1,600	22,585									24,185	
Omineca and Peace River		72		35,618	10,249									45,939	
Central District (No. 3)															45,380
Nicola, Vernon, and Kamloops			3,500	7,174	28,311	3,485				2,433	477			45,380	
Southern District (No. 4)															39,213
Grand Forks and Greenwood				5,500	2,620									8,120	
Osoyoos		4,560		1,627	18,009									24,196	
Similkameen				957	5,366								574	6,897	
Eastern District (No. 5)															142,412
Fort Steele			620	23,919	37,101									61,640	
Windermere and Golden				5,216	6,750									11,966	
Ainsworth					14,263									14,263	
Slocan and Slocan City															
Nelson			4,796	7,032	16,939									28,767	
Trail Creek				1,300	19,702									21,002	
Revelstoke				397	4,377									4,774	
Western District (No. 6)															1,428,534
Nanaimo and Alberni		104,789	123,860	3,512	16,361	7,419	113			934				256,988	
Victoria and Quatsino	516,931	10,167		30,014	57,240	14,286					5,980	2,875	793	638,286	
Lillooet				5,253	7,160									12,413	
Yale					19,500									19,500	
Clinton															
Ashcroft				7,749										7,749	
Vancouver			42,450	10,654	54,120									107,224	
New Westminster		7,000		48,172	89,284	21,247	19,500	115,121	7,657	30,077	47,722		594	386,374	
Totals	516,931	137,158	175,226	208,178	477,897	46,437	19,613	115,121	7,657	33,444	54,179	2,875	1,961	1,796,677	1,796,677

TABLE XI.—PRODUCTION IN DETAIL OF MISCELLANEOUS METALS, MINERALS, AND MATERIALS, 1936.

District and Division.	Bismuth.	Cadmium.	Diatomite.	Flux (Limestone and Quartz).	Gypsum Products.	Iron (Bog and Ochre).	Platinum.	Slate and Greenrock Granules.	Soda and Magnesium Sulphate.	Sulphur (Elemental) and Sulphur Content of Pyrite and Sulphuric Acid Manufactured.	Talc.	Others.	Division Totals.	District Totals.
	$	$	$	$	$	$	$	$	$	$	$	$	$	$
North-western District (No. 1)														558
Atlin, Stikine, and Liard														
Nass River														
Portland Canal														
Skeena and Queen Charlotte														
Bella Coola														
North-eastern District (No. 2)			350					168					518	
Cariboo and Quesnel							40						40	
Omineca and Peace River														138,137
Central District (No. 3)					124,425				13,712				138,137	
Nicola, Vernon, and Kamloops														13,033
Southern District (No. 4)				11,436									11,436	
Grand Forks and Greenwood				788			809						1,597	
Osoyoos and Similkameen														1,275,610
Eastern District (No. 5)														
Fort Steele														
Windermere and Golden														
Ainsworth														
Slocan and Slocan City														
Nelson and Arrow Lake				2,328									2,328	
Trail Creek and Revelstoke	357,007	468,170								448,110			1,273,287	
Western District (No. 6)														219,058
Nanaimo and Alberni				8									8	
Victoria and Quatsino								2,479					2,479	
Lillooet and Clinton							81		1,677		162		1,920	
Yale and Ashcroft												49,971	49,971	
Vancouver and New Westminster						4,000				160,680			164,680	
Totals	357,007	468,170	350	14,555	124,425	4,000	930	2,647	15,389	608,790	162	49,971	1,646,396	1,646,396

TABLE XII.—British Columbia Mine Production, 1895–1936.

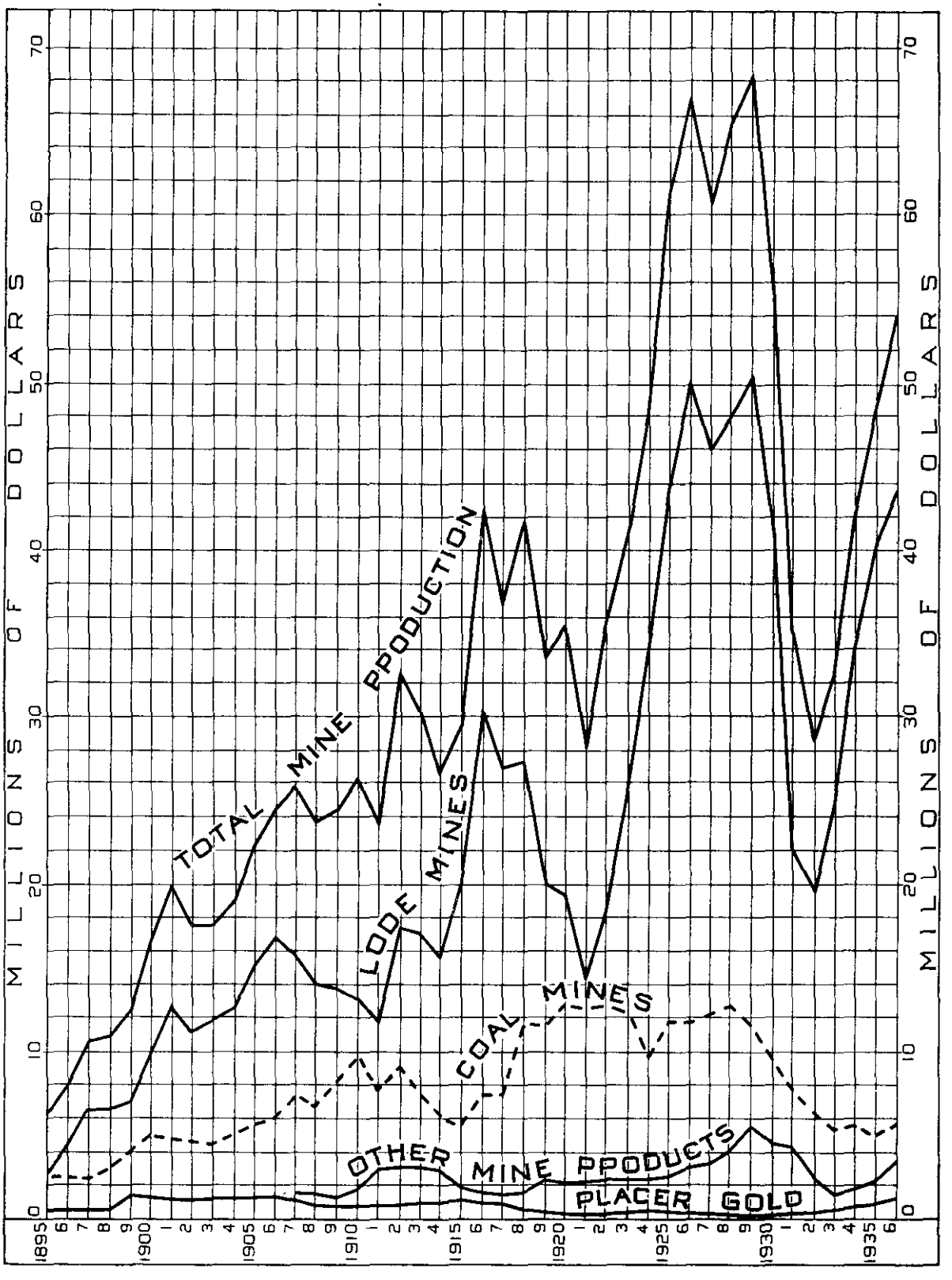


TABLE XIII.—Production of Lode Mines in British Columbia, 1913–1936.

TABLE XIV.—Coal Production per Year to Date.*

	Tons. (2,240 lb.)	Value.		Tons. (2,240 lb.)	Value.
1836–1885	3,029,011	$9,468,557	1912	2,628,804	$9,200,814
1886	326,636	979,908	1913	2,137,483	7,481,190
1887	413,360	1,240,080	1914	1,810,967	6,338,385
1888	489,301	1,467,903	1915	1,611,129	5,638,952
1889	579,830	1,739,490	1916	2,084,093	7,294,325
1890	678,140	2,034,420	1917	2,149,975	7,524,913
1891	1,029,097	3,087,291	1918	2,302,245	11,511,225
1892	826,335	2,479,005	1919	2,267,541	11,337,705
1893	978,294	2,934,882	1920	2,595,125	12,975,625
1894	1,012,953	3,038,859	1921	2,483,995	12,419,975
1895	939,654	2,818,962	1922	2,511,843	12,559,215
1896	896,222	2,688,666	1923	2,453,223	12,266,115
1897	882,854	2,648,562	1924	1,939,526	9,697,630
1898	1,135,865	3,407,595	1925	2,328,522	11,642,610
1899	1,306,324	3,918,972	1926	2,330,036	11,650,180
1900	1,439,595	4,318,785	1927	2,453,827	12,269,135
1901	1,460,331	4,380,993	1928	2,526,702	12,633,510
1902	1,397,394	4,192,182	1929	2,251,252	11,256,260
1903	1,168,194	3,504,582	1930	1,887,130	9,435,650
1904	1,253,628	3,760,884	1931	1,707,590	7,684,155
1905	1,384,312	4,152,936	1932	1,534,975	6,523,644
1906	1,517,303	4,551,909	1933	1,264,746	5,375,171
1907	1,800,067	6,300,235	1934	1,347,090	5,725,133
1908	1,677,849	5,872,472	1935	1,187,968	5,048,864
1909	2,006,476	7,022,666	1936	1,346,471	5,722,502
1910	2,800,046	9,800,161			
1911	2,193,062	7,675,717	Totals	85,764,891	$340,699,557

* For all years to 1925 (inclusive) figures are net coal production and do not include coal made into coke; subsequent figures are entire coal production, including coal made into coke.

TABLE XV.—Coke Production from Bee-hive Ovens in British Columbia from 1895 to 1925.

	Tons. (2,240 lb.)	Value.		Tons. (2,240 lb.)	Value.
1895–97	19,396	$96,980	1913	286,045	$1,716,270
1898 (estimated)	35,000	175,000	1914	234,577	1,407,462
1899	34,251	171,255	1915	245,871	1,475,226
1900	85,149	425,745	1916	267,725	1,606,350
1901	127,081	635,405	1917	159,905	959,430
1902	128,015	640,075	1918	188,967	1,322,769
1903	165,543	827,715	1919	91,138	637,966
1904	238,428	1,192,140	1920	67,792	474,544
1905	271,785	1,358,925	1921	59,434	416,038
1906	199,227	996,135	1922	45,835	320,845
1907	222,913	1,337,478	1923	58,919	412,433
1908	247,399	1,484,394	1924	30,615	214,305
1909	258,703	1,552,218	1925	75,185	526,295
1910	218,029	1,308,174			
1911	66,005	396,030	Totals	4,393,255	$25,673,600
1912	264,333	1,585,998			

TABLE XVI.—Coke and By-products Production of British Columbia, 1935 and 1936.

Description.	1935.		1936.	
	Quantity.	Value.	Quantity.	Value.
Coal used in making coke, long tons	114,104	$494,492	112,348	$436,595
Coke made in bee-hive ovens, long tons	24,170	$160,565	30,370	$191,843
Coke made in by-product ovens, long tons	13,316	109,684	.....	.....
Coke made in gas plants, long tons	41,177	160,694	43,632	138,787
Total coke made, long tons	78,663	$430,943	74,002	$330,630
Gas made, purchased, and sold	.....	1,430,057	.....	1,422,783
Tar produced	.....	44,876	.....	38,872
Other by-products	.....	3,081	.....	.....
Total production value of coke industry	.....	$1,908,957	.....	$1,792,285

TABLE XVII.—Dividends paid by Mining Companies, 1897–1936.

Lode-gold Mines.

Company or Mine.	Locality.	Class.	Amount paid.
Arlington	Erie	Gold	$42,678
Athabasca	Nelson	Gold	25,000
Bralorne	Bridge River	Gold	1,486,150
Belmont-Surf Inlet	Princess Royal Island	Gold	1,437,500
Cariboo Gold Quartz	Wells	Gold	133,331
Cariboo-McKinney	Camp McKinney	Gold	565,588
Canadian Pacific Exploration	Nelson	Gold	37,500
Centre Star	Rossland	Gold	472,255
Fern	Nelson	Gold	15,000
Goodenough	Ymir	Gold	13,931
Island Mountain	Wells	Gold	105,072
I.X.L.	Rossland	Gold	131,633
Jewel-Denero	Greenwood	Gold	11,751
Le Roi Mining Co.	Rossland	Gold	1,475,000
Le Roi No. 2	Rossland	Gold	1,574,640
Lorne	Bridge River	Gold	20,450
Nickel Plate	Hedley	Gold	3,423,191
Pioneer	Bridge River	Gold	5,130,198
Poorman	Nelson	Gold	25,000
Premier	Premier	Gold	18,858,075
Queen	Sheep Creek	Gold	85,000
Relief	Erie	Gold	5,000
Reno	Sheep Creek	Gold	474,840
Sheep Creek Mines, Ltd.	Sheep Creek	Gold	112,500
Sunset No. 2	Rossland	Gold	115,007
War Eagle	Rossland	Gold	1,245,250
Motherlode	Sheep Creek	Gold	162,500
Ymir Gold	*Ymir*	Gold	300,000
Ymir Yankee Girl	Ymir	Gold	111,250
Miscellaneous mines		Gold	23,530
Total, lode-gold mines			$37,618,815

The gold-copper properties of Rossland are included in this table.

Silver-lead-zinc Mines.

Antoine	Rambler	Silver-lead-zinc	$10,000
Beaverdell-Wellington	Beaverdell	Silver-lead-zinc	79,200
Bell	Beaverdell	Silver-lead-zinc	476,297
Bosun (Rosebery-Surprise)	New Denver	Silver-lead-zinc	27,500
Capella	New Denver	Silver-lead-zinc	5,500
Consolidated Mining and Smelting Co. of Canada, Ltd.	Trail	Silver-lead-zinc	60,211,325
Couverapee	Field	Silver-lead-zinc	5,203
Duthie Mines, Ltd.	Smithers	Silver-lead-zinc	50,000
Florence Silver	Ainsworth	Silver-lead-zinc	35,393
Goodenough	Cody	Silver-lead-zinc	45,668
H.B. *Mining Co.*	Hall Creek	Silver-lead-zinc	8,904
Highland Lass, Ltd.	Beaverdell	Silver-lead-zinc	132,464
Highland-Bell, Ltd.	Beaverdell	Silver-lead-zinc	14,803
Horn Silver	Similkameen	Silver-lead-zinc	6,000
Idaho-Alamo	Sandon	Silver-lead-zinc	400,000
Iron Mountain (Emerald)	Salmo	Silver-lead-zinc	20,000
Jackson	Retallack	Silver-lead-zinc	20,000
Last Chance	Three Forks	Silver-lead-zinc	213,109
Lone Batchelor	Sandon	Silver-lead-zinc	50,000
Lucky Jim	Three Forks	Silver-lead-zinc	80,000
Mercury	Sandon	Silver-lead-zinc	6,000
Meteor	Slocan City	Silver-lead-zinc	10,257
Carried forward			

TABLE XVII.—DIVIDENDS PAID BY MINING COMPANIES, 1897–1936—*Continued.*

Silver-lead-zinc Mines—Continued.

Company or Mine.	Locality.	Class.	Amount paid.
Brought forward			
Monitor and Ajax	Three Forks	Silver-lead-zinc	27,500
Mountain Con	Cody	Silver-lead-zinc	71,387
McAllister	Three Forks	Silver-lead-zinc	33,694
Noble Five	Cody	Silver-lead-zinc	72,859
North Star	Kimberley	Silver-lead-zinc	496,901
No. One	Sandon	Silver-lead-zinc	6,754
Ottawa	Slocan City	Silver-lead-zinc	107,928
Payne	Sandon	Silver-lead-zinc	1,438,000
Providence	Greenwood	Silver-lead-zinc	33,810
Queen Bess	Alamo	Silver-lead-zinc	25,000
Rambler-Cariboo	Rambler	Silver-lead-zinc	575,000
Reco	Cody	Silver-lead-zinc	332,492
Ruth Mines, Ltd.	Sandon	Silver-lead-zinc	165,000
St. Eugene	Moyie	Silver-lead-zinc	566,000
Silversmith	Sandon	Silver-lead-zinc	725,000
Slocan Silver	Alamo	Silver-lead-zinc	11,600
Slocan Star	Sandon	Silver-lead-zinc	567,500
Spokane-Trinket	Ainsworth	Silver-lead-zinc	9,564
Standard Silver Lead	Silverton	Silver-lead-zinc	2,700,000
Sunset and Trade Dollar	Retallack	Silver-lead-zinc	88,000
Utica	Kaslo	Silver-lead-zinc	64,000
Wallace Mines, Ltd. (*Sally*)	Beaverdell	Silver-lead-zinc	135,000
Washington	Rambler Station	Silver-lead-zinc	38,000
Whitewater	Retallack	Silver-lead-zinc	592,515
Miscellaneous mines		Silver-lead-zinc	70,237
Total, silver-lead-zinc mines			$70,861,364

Copper Mines.

Britannia M. & S. Co.*	Britannia Beach	Copper	$6,552,578
Canada Copper Corporation	Greenwood	Copper	615,399
Cornell	Texada Island	Copper	8,500
Granby Cons. M.S. & P. Co.†	Anyox	Copper	8,025,471
Marble Bay	Texada Island	Copper	175,000
Hall Mines	Nelson	Copper	160,000
Miscellaneous mines		Copper	260,770
Total, copper mines			$15,797,718

* The Howe Sound Company is the holding company for the *Britannia* mine in British Columbia and other mines in Mexico and the State of Washington. Dividends paid by the Howe Sound Company are therefore derived from all operations, and in the foregoing table the dividends credited to the *Britannia* mine have been paid by the Britannia Mining and Smelting Company, Limited, none being credited subsequent to 1930. In making comparison with yearly totals the amounts credited to the Howe Sound Company have been deducted for the years shown, so the total in the annual report concerned will show the higher figure.

† The amount shown to the credit of the Granby Consolidated Mining, Smelting, and Power Company, Limited, does not include the sum of $6,749,996 paid by the company during 1935 and 1936 as a distribution or repayment of capital, subsequent to the closing-down of its operations at Anyox and the company going into voluntary liquidation. Operations ceased at Anyox in August, 1935. The company since that date has revived its business charter and will conduct operations at Allenby, B.C.

The term "Miscellaneous" noted in each class of dividend covers all payments of $5,000 and under, together with payments made by companies or individuals requesting that the item be not disclosed.

In compiling the foregoing table of dividends paid, the Department wishes to acknowledge the kind assistance given by companies, individuals, and trade journals in giving information on the subject.

TABLE XVII.—DIVIDENDS PAID BY MINING COMPANIES, 1897–1936—*Continued.*

Coal.

Wellington Collieries, Ltd., Nanaimo	$16,000,000
Crow's Nest Pass Coal Co., Ltd., Fernie	11,733,456
Total	$27,733,456

Miscellaneous and Structural.

Various	$1,376,600

Aggregate of all Classes.

Lode-gold mining	$37,618,815
Silver-lead-zinc mining	70,861,364
Copper-mining	15,797,718
Coal-mining	27,733,456
Miscellaneous and structural	1,376,600
Total	$153,387,953

Dividends paid during 1927–1936, inclusive.

Year.	Amount paid.	Year.	Amount paid.
1927	$8,816,681	1933	$2,471,735
1928	9,572,536	1934	4,745,905
1929	11,263,118	1935	7,386,070
1930	10,543,500	1936	10,513,705
1931	4,650,857		
1932	2,786,958	Total	$72,751,065

Dividends paid during 1935 and 1936.

Company.	1935.	1936.
Beaverdell-Wellington	$36,000	$18,000
Bell Mines, Ltd.	50,501	25,403
Bralorne Mines, Ltd.	300,000	561,150
Cariboo Gold Quartz Mines, Ltd.	.....	133,331
The Consolidated Mining and Smelting Co. of Canada, Ltd.	4,232,452	6,515,943
Crow's Nest Pass Coal Co., Ltd.	372,708	434,826
Highland Bell, Ltd.	.....	14,803
Highland Lass, Ltd.	52,369	.....
Island Mountain Mines, Ltd.	.....	105,072
Pioneer Gold Mines of B.C., Ltd.	1,401,400	1,401,400
Premier Gold Mining Co, Ltd.	650,000	800,000
Reno Gold Mines, Ltd.	255,683	219,157
Sheep Creek Gold Mines, Ltd.	.....	112,500
Ymir Yankee Girl Mines, Ltd.	.....	111,250
Others	34,957	60,870
Totals	$7,386,070	$10,513,705

TABLE XVIII.—Capital employed, Salaries and Wages, Fuel and Electricity, and Process Supplies, 1936.

Mineral Survey District and Class.	Capital employed.	Salaries and Wages.	Fuel and Electricity.	Process Supplies.
	$	$	$	$
No. 1, North-western—				
Lode-mining	6,904,235	952,070	41,531	321,002
Placer-mining	148,361	166,451	18,987	11,729
Coal-mining	.....	.....	.....	.....
Miscellaneous	.....	.....	.....	.....
Structural	178,308	12,881	16,816	2,903
Totals	7,231,004	1,132,402	77,334	335,634
No. 2, North-eastern—				
Lode-mining	3,393,608	604,720	71,893	142,831
Placer-mining	3,914,498	433,668	33,176	14,962
Coal-mining	37,112	28,676	.....	.....
Miscellaneous	550	.....	.....	.....
Structural	.....	.....	.....	.....
Totals	7,345,768	1,067,064	105,069	157,793
No. 3, Central—				
Lode-mining	1,449,210	166,526	24,526	47,816
Placer-mining	107,131	22,600	750	200
Coal-mining	123,737	92,931	6,663	.....
Miscellaneous	228,947	49,503	10,793	1,919
Structural	25,932	5,404	959	25
Totals	1,934,987	336,964	43,691	49,960
No. 4, Southern—				
Lode-mining	4,829,310	594,549	53,482	247,423
Placer-mining	12,000	2,578	.....	.....
Coal-mining	2,875,597	389,481	62,691	165
Miscellaneous	.....	.....	.....	.....
Structural	.....	1,200	1,912	55
Totals	7,716,907	987,808	118,085	247,643
No. 5, Eastern—				
Lode-mining	63,912,659	7,508,670	1,999,520	1,920,000
Placer-mining	48,400	17,437	684	3,711
Coal-mining	6,343,164	793,788	26,165	.....
Miscellaneous	498,049	48,694	632	12
Structural	33,284	5,065	522	130
Totals	70,835,556	8,373,654	1,727,523	1,923,853
No. 6, Western—				
Lode-mining	18,894,236	2,778,648	241,395	1,488,723
Placer-mining	524,552	7,490	62	12
Coal-mining	10,757,686	2,317,298	210,301	.....
Miscellaneous	15,246,809	497,723	129,834	163,302
Structural	2,175,560	388,568	70,850	67,081
Totals	47,598,843	5,989,727	652,442	1,719,618
Grand totals, 1936	142,663,065	17,887,619	2,724,144	4,434,501
Grand totals, 1935	143,239,953	16,753,367	2,619,639	4,552,730

Note.—The above figures, compiled from returns on the subject made by companies and individuals, illustrate the amount of capital employed in the mining industry in 1936, the amount of money distributed in salaries and wages, fuel and electricity, and process supplies (explosives, chemicals, drill-steel, lubricants, etc.).

Capital employed includes: Present cash value of the land (excluding minerals); present value of buildings, fixtures, machinery, tools, and other equipment; inventory value of materials on hand, ore in process, fuel and miscellaneous supplies on hand; inventory value of finished products on hand; operating capital (cash, bills and accounts receivable, prepaid expenses, etc.).

TABLE XIX.—Tonnage, Number of Mines, Net and Gross Value of Lode Minerals, 1901–1936.

District.	Year.	Tonnage.	No. of Shipping-mines.	No. of Mines Shipping over 100 Tons.	Net Value to Shipper of Lode Minerals produced.	Gross Value of Lode Minerals produced.
	1901	920,416	119	78	.....	$14,100,282
	1902	998,999	124	75	.....	11,581,153
	1903	1,286,176	125	74	.....	12,103,237
	1904	1,461,609	142	76	.....	12,909,035
	1905	1,706,679	146	79	.....	15,980,164
	1906	1,963,872	154	77	.....	18,484,102
	1907	1,804,114	147	72	.....	17,316,847
	1908	2,083,606	108	59	.....	15,847,411
	1909	2,057,713	89	52	.....	15,451,141
	1910	2,216,428	83	50	.....	14,728,731
	1911	1,770,755	80	45	.....	11,454,063
	1912	2,688,532	86	51	.....	17,662,766
	1913	2,663,809	110	58	.....	17,190,838
	1914	2,175,971	98	56	.....	15,225,061
	1915	2,690,110	132	59	.....	19,992,149
	1916	3,188,865	169	81	.....	31,483,014
	1917	2,761,579	193	87	.....	26,788,474
	1918	2,892,849	175	80	.....	27,590,278
	1919	2,112,975	144	74	.....	19,750,498
	1920	2,178,187	121	60	.....	19,444,365
	1921	1,562,645	80	35	.....	12,920,398
	1922	1,573,186	98	33	.....	19,227,857
	1923	2,421,839	77	28	.....	25,347,092
	1924	3,397,105	86	37	.....	35,538,247
	1925	3,849,269	102	40	.....	46,200,135
	1926	4,775,073	138	55	$38,558,613	51,508,031
	1927	5,416,021	132	52	27,750,364	44,977,082
	1928	6,241,310	110	49	29,070,075	48,281,825
	1929	6,977,681	106	48	34,713,887	51,174,859
	1930	6,803,846	68	32	21,977,688	40,915,395
	1931	5,549,103	44	22	9,513,931	22,535,573
	1932	4,340,158	75	29	7,075,393	19,700,235
	1933	4,030,778	109	47	13,976,368	25,007,137
	1934	5,087,334	145	69	20,243,278	33,895,930
	1935	4,916,149	177	72	25,407,914	40,597,569
No. 1 District	**1936**	**228,321**	**20**	**10**	**2,065,699**	.....
No. 2 District	**1936**	**95,419**	**3**	**2**	**1,286,690**	.....
No. 3 District	**1936**	**37,273**	**7**	**3**	**285,514**	.....
No. 4 District	**1936**	**138,649**	**35**	**16**	**1,739,428**	.....
No. 5 District	**1936**	**2,242,681**	**82**	**29**	**17,511,877**	.....
No. 6 District	**1936**	**1,714,178**	**21**	**10**	**7,086,400**	.....
Totals	**1936**	**4,456,521**	**168**	**70**	**$29,975,608**	**$43,666,452**
Grand totals	1901–1936	113,021,268	.....	....	.....	916,577,426

TABLE XX.—Men employed in the Mining Industry of British Columbia, 1901–1936.

District.	Year.	Placer-mining.	Lode-mining.					Coal-mining.			Structural Materials.		Miscellaneous.	Total.
			Under.	Above.	Total.	In Concentrators.	In Smelters.	Under.	Above.	Total.	Quarries and Pits.	Plants.		
	1901	.....	2,736	1,212	3,948	.....	.....	3,041	931	3,974	.....	.....	.....	7,922
	1902	.....	2,219	1,126	3,345	.....	.....	3,101	910	4,011	.....	.....	.....	7,356
	1903	.....	1,662	1,088	2,750	.....	.....	3,137	1,127	4,264	.....	.....	.....	7,014
	1904	.....	2,143	1,163	3,306	.....	.....	3,278	1,175	4,453	.....	.....	.....	7,759
	1905	.....	2,470	1,240	3,710	.....	.....	3,127	1,280	4,407	.....	.....	.....	8,117
	1906	.....	2,680	1,303	3,983	.....	.....	3,415	1,390	4,805	.....	.....	.....	8,788
	1907	.....	2,704	1,239	3,943	.....	.....	2,862	907	3,769	.....	.....	.....	7,712
	1908	.....	2,567	1,127	3,694	.....	.....	4,432	1,641	6,073	.....	.....	.....	9,767
	1909	.....	2,184	1,070	3,254	.....	.....	4,713	1,705	6,418	.....	.....	.....	9,672
	1910	.....	2,472	1,237	3,709	.....	.....	5,903	1,855	7,758	.....	.....	.....	11,467
	1911	.....	2,435	1,159	3,594	.....	.....	5,212	1,661	6,873	.....	.....	.....	10,467
	1912	.....	2,472	1,364	3,837	.....	.....	5,275	1,855	7,130	.....	.....	.....	10,967
	1913	.....	2,773	1,505	4,278	.....	.....	4,950	1,721	6,671	.....	.....	.....	10,949
	1914	.....	2,741	1,433	4,174	.....	.....	4,267	1,465	5,732	.....	.....	.....	9,906
	1915	.....	2,709	1,435	4,144	.....	.....	3,708	1,283	4,991	.....	.....	.....	9,135
	1916	.....	3,857	2,036	5,393	.....	.....	3,694	1,366	5,060	.....	.....	.....	10,453
	1917	.....	3,290	2,198	5,488	.....	.....	3,760	1,410	5,170	.....	.....	.....	10,658
	1918	.....	2,626	1,764	4,390	.....	.....	3,658	1,769	5,247	.....	.....	.....	9,637
	1919	.....	2,513	1,746	4,259	.....	.....	4,145	1,821	5,966	.....	.....	.....	10,225
	1920	.....	2,074	1,605	3,679	.....	.....	4,191	2,158	6,349	.....	.....	.....	10,028
	1921	.....	1,355	975	2,330	.....	.....	4,722	2,163	6,885	.....	.....	.....	9,215
	1922	.....	1,510	1,239	2,749	.....	.....	4,712	1,932	6,644	.....	.....	.....	9,393
	1923	.....	2,102	1,516	3,618	.....	.....	4,342	1,807	6,149	.....	.....	.....	9,767
	1924	.....	2,353	1,680	4,033	.....	.....	3,894	1,524	5,418	.....	.....	.....	9,451
	1925	.....	2,298	2,840	5,138	.....	.....	3,828	1,615	5,443	.....	.....	.....	10,581
	1926	299	2,606	1,735	4,341	808	2,461	3,757	1,565	5,322	493	324	124	14,172
	1927	415	2,671	1,916	4,587	854	2,842	3,646	1,579	5,225	647	138	122	14,830
	1928	355	2,707	2,469	5,176	911	2,748	3,814	1,520	5,334	412	368	120	15,424
	1929	341	2,926	2,052	4,978	966	2,948	3,675	1,353	5,028	492	544	268	15,565
	1930	425	2,316	1,260	3,576	832	3,197	3,389	1,256	4,645	843	344	176	14,032
	1931	688	1,463	834	2,297	581	3,157	2,957	1,125	4,082	460	526	380	12,171
	1932	874	1,355	900	2,255	542	2,036	2,628	980	3,608	536	329	344	10,524
	1933	1,134	1,786	1,335	3,121	531	2,436	2,241	853	3,094	376	269	408	11,369
	1934	1,122	2,796	1,729	4,525	631	2,890	2,050	843	2,893	377	187	360	12,985
	1935	1,291	2,740	1,497	4,237	907	2,771	2,145	826	2,971	536	270	754	13,737
No. 1 District	**1936**	**276**	**257**	**328**	**585**	**57**	.....	.....	.....	.....	**71**	.....	.....	**989**
No. 2 District	**1936**	**633**	**231**	**133**	**364**	**28**	.....	**8**	**2**	**10**	**80**	.....	.....	**1,146**
No. 3 District	**1936**	**31**	**63**	**50**	**113**	**16**	.....	**77**	**33**	**110**	**41**	**7**	**14**	**332**
No. 4 District	**1936**	**31**	**243**	**154**	**402**	**125**	.....	**287**	**143**	**415**	**58**	**1**	**1**	**1,031**
No. 5 District	**1936**	**54**	**1,140**	**548**	**1,688**	**343**	**2,678**	**459**	**147**	**606**	**191**	**2**	**590**	**6,152**
No. 6 District	**1936**	**99**	**1,020**	**627**	**1,647**	**151**	.....	**1,204**	**469**	**1,673**	**492**	**278**	**220**	**4,560**
Totals	**1936**	**1,124**	**2,959**	**1,840**	**4,799**	**720**	**2,678**	**2,015**	**799**	**2,814**	**931**	**288**	**826**	**14,180**

TABLE XXI.—Metalliferous Mines shipping in 1936.

Mine or Group.	Location of Mine or Mill.	Owner or Agent.	Rated Daily Capacity.		Operating at.	Date of First Operation.	Process.	Character of Ore.
			1935.	1936.				
			Tons.	Tons.	Tons.			
Banker	Tulsequah, Taku River	J. F. Mullen, Juneau, Alaska						Silver, gold, lead.
Dunwell	Stewart	Welldun M.M. & Power Co., Stewart	20	20	20	1927	Flotation	Silver, gold, lead.
Lakeview	Stewart	Rochfort *et al.*, leasers						Silver, gold, lead.
Mayflower	Stewart							Silver, gold.
Morning	Stewart	S. Deschamps, Stewart						Silver, lead.
Premier	Salmon River	Silbak Premier Mines, Ltd.	500	500	500	July, 1922	Flotation	Gold, silver, lead, copper.
United Empire	Stewart	United Empire Gold and Silver Mining Co., Ltd., Vancouver						Silver, gold, lead.
Casey & Morin	Stewart	A. R. Casey and J. Morin, Stewart						Gold, silver.
McDonald, B. T.	Stewart	B. T. McDonald, Stewart						Silver, copper, lead.
Rennie, J.	Stewart	John Rennie, Stewart						Silver, gold, lead, copper.
Kansas	Stewart	S. Deschamps, Stewart						Silver, gold, lead.
Edye Pass	Refuge Bay, Porcher Island	F. J. Patterson and Reward Mining Co., Ltd., Porcher Island						Gold, silver.
Surf Inlet	Princess Royal Island	Surf Inlet Cons. Gold Mines, Ltd., Vancouver	100	100	‡100	Aug., 1917	Table concentration; flotation	Gold, silver, copper.
Surf Point	Porcher Island	N. A. Timmins Corporation, Porcher Island	20	22	22	July, 1933	Flotation	Gold, silver.
Esperanza	Alice Arm, Kitsault River	Esperanza Mines, Ltd., Victoria		20	20	Aug., 1936	Flotation	Silver, gold, copper, lead.
Eklund (Granby Point mine)	Anyox	C. Eklund, leaser, Anyox						Silver, gold, lead.
Granby	Anyox	Granby M.S. & P. Co., Vancouver	*					Clean-up material.
Easter	Queen Charlotte City	Skidegate Gold Mines, Ltd.		50	50	Nov., 1936	Cyanidation	Gold, silver.
Cariboo Gold	Wells	Cariboo Gold Quartz Mining Co., Ltd., Wells	150	200	200	Jan., 1933	Cyanidation	Gold, silver.
Island Mountain	Wells	Island Mountain Mines, Ltd., Wells	100	125	125	Nov., 1934	Cyanidation	Gold, silver.
Silver Pick (formerly Little Joe)	Smithers	J. J. Herman, Grand Forks						Silver, gold, lead, zinc.
Homestake	Adams Lake	Kamloops Homestake Mines, Ltd., Vancouver	50	50	‡50	Oct., 1935	Flotation	Gold, silver, lead.
Windpass	Dunn Lake, near Chu Chua	Windpass Gold Mining Co., Ltd., Vancouver	60	50	50	Mar., 1934	Flotation	Gold, silver, copper.
Planet	Stump Lake	Nicola Mines and Metals, Ltd., Vancouver	100	60	60	1929	Flotation	Gold, silver, lead, copper.
Kalamalka	Lavington	Kalamalka Gold Mines, Ltd., Vancouver						Gold, silver, copper.
Lightning Peak	Edgewood	W. A. Calder, Edgewood						Silver, lead, zinc.

* Closed down, August, 1935. ‡ Intermittent.

TABLE XXI.—METALLIFEROUS MINES SHIPPING IN 1936—*Continued.*

Mine or Group.	Location of Mine or Mill.	Owner or Agent.	Rated Daily Capacity.		Operating at.	Date of First Operation.	Process.	Character of Ore.
			1935.	1936.				
			Tons.	Tons.	Tons.			
Skookum	Vernon	Jardave Exploration Syndicate, Vancouver	.....	.....	.....	.....	.....	Silver, gold, lead.
Empire	Oliver	H. J. Edmonds, Oliver	.....	.....	.....	.....	.....	Silver, gold.
Fairview-Amalgamated	Fairview	Fairview Amalgamated Gold Mines, Ltd., Vancouver	100	100	100	Aug., 1935	Amalgamation; blanket-tables; flotation	Gold, silver, lead.
Gold Standard	Oro Fino Mountain	Gold Standard (Fairview) Mining Co., Ltd., Penticton	.....	.....	.....	.....	.....	Gold, silver.
Grandora	Oliver	Grandoro Mines, Ltd., Vancouver	.....	.....	.....	.....	.....	Gold.
Hedley Mascot	Hedley	Hedley Mascot Gold Mines, Ltd., Vancouver	.....	150	150	May, 1936	Flotation	Gold, silver, copper.
Kelowna Exploration	Hedley	Kelowna Exploration Co., Ltd., Hedley	200	200	200	Sept., 1934	Cyanidation; flotation	Gold, silver, copper.
Osoyoos	Osoyoos	Osoyoos Mines, Ltd., Calgary	50	50	50	Mar., 1936	Table concentration; flotation	Gold, silver, copper.
English & French	Grand Forks	D. M. McKay, Grand Forks	.....	.....	.....	.....	.....	Silver, lead, zinc.
Union	Granby River, Grand Forks	J. F. McCarthy, Grand Forks	200	200	†200	Jan., 1930	Cyanidation	Gold, silver.
Yankee Boy	Grand Forks	Reigel Mines, Ltd., Grand Forks	.....	.....	.....	.....	.....	Gold, silver.
Athelstan	Phoenix	W. E. McArthur, Jr., Greenwood	.....	.....	.....	.....	.....	Gold, silver.
Amandy	Jewel Lake	E. C. Henniger, Grand Forks	.....	.....	.....	.....	.....	Gold, silver.
Amandy	Jewel Lake	V. Falsetto, C. W. Gibbard, J. Flaten, and J. Henderson, Rossland	.....	.....	.....	.....	.....	Gold, silver.
Bay	Greenwood	W. E. McArthur, Jr., Greenwood	.....	.....	.....	.....	.....	Gold, silver.
Beaver	Beaverdell	Beaver Silver Mines, Ltd., Greenwood	.....	.....	.....	.....	.....	Silver, gold, zinc, lead.
Bell	Beaverdell	Bell Mines, Ltd., Penticton	.....	.....	.....	.....	.....	Silver, gold, zinc, lead.
Brooklyn	Greenwood	W. E. McArthur, Jr., Greenwood	.....	.....	.....	.....	.....	Silver, gold, copper.
Carmi	Carmi	R. Legiest *et al.*, Carmi	.....	.....	.....	.....	.....	Gold, silver.
Dentonia	Jewel Lake	Dentonia Mines, Ltd., Calgary	100	100	100	April, 1934	Flotation	Gold, silver, lead.
Dynamo	Greenwood	R. Forshaw, Greenwood	.....	.....	.....	.....	.....	Gold, silver.
Granby (Phoenix)	Greenwood	W. E. McArthur, Jr., Greenwood	.....	50	50	Sept., 1936	Flotation	Silver, gold, copper.
Highland Bell	Beaverdell	Highland Bell, Ltd., Penticton	.....	.....	.....	.....	.....	Silver, gold, zinc, lead.
Highland Lass, Ltd.	Beaverdell	Highland Lass, Ltd., Kelowna	.....	.....	.....	.....	.....	Silver, gold, zinc, lead.
Imperial	Rock Creek	D. M. McKay, Grand Forks	.....	.....	.....	.....	.....	Silver, gold, zinc, lead.
Keno	Greenwood	L. Manzini *et al.*, Greenwood	.....	.....	.....	.....	.....	Silver, gold, zinc.
Mogul	Rock Creek	C. Sherdahl *et al.*, Rossland	.....	.....	.....	.....	.....	Gold, silver.
North Star	Greenwood	W. E. McArthur, Jr., Greenwood	.....	.....	.....	.....	.....	Gold, silver.
Number Seven	Greenwood	W. E. McArthur, Jr., Greenwood	.....	.....	.....	.....	.....	Silver, gold, lead.
Providence	Greenwood	Wm. Madden, Greenwood	.....	.....	.....	.....	.....	Silver, gold, zinc, lead.
Rambler	Beaverdell	H. E. Growdon, Beaverdell	.....	.....	.....	.....	.....	Silver, zinc, lead.

† Tailings treated; mill dismantled, August, 1935.

			Tons.	Tons.	Tons.			
Sally	Beaverdell	Sally Mines, Ltd., Penticton						Silver, gold, zinc, lead.
Silver Cloud	Greenwood	Mrs. E. Hallett, Greenwood						Silver, gold, lead, zinc.
Skylark	Greenwood	W. E. McArthur, Jr., Greenwood						Silver, gold, zinc, lead.
Tiger	Beaverdell	J. L. Nordman & Partner, Beaverdell						Silver, zinc, lead.
Wellington	Beaverdell	Beaverdell-Wellington Syndicate, Greenwood						Silver, gold, zinc, lead.
Hanson	Tulameen	Max Hanson, Tulameen						Gold, silver.
Silver Key	Canal Flats	Messrs. Bryant and A. McLeod, Canal Flats						Silver.
Sullivan	Kimberley	Consolidated M.S. & P. Co. of Canada, Ltd., Trail	6,000	6,000	6,000	Aug., 1923	Flotation	Silver, lead, zinc.
Gold Viking	Slocan City	Geo. Henderson, Slocan City						Silver, gold.
Little Daisy	Slocan City	A. Erickson, Slocan City						Silver, gold.
Meteor	Slocan City	R. J. Johnson *et al.*, Slocan City						Silver, gold.
Morning Star	Springer Creek	H. E. Scovil, Slocan						Silver, gold, lead, zinc.
Black Colt	Sandon	E. J. Vandergrift, Sandon						Silver, gold, lead, zinc.
Bosun	New Denver	J. L. Irwin, agent, New Denver						Silver, gold, zinc, lead.
Chapleau	Slocan City	A. G. Ewing *et al.*, Slocan City						Silver, gold.
Cinderella	Sandon	G. B. Dean and E. Doney, Sandon						Silver, lead.
Cliff	Silverton	J. H. Dalzell, leaser, Silverton						Silver, lead, zinc.
Elkhorn	Sandon	A. T. Forsythe *et al.*, Sandon						Silver, lead, zinc.
Hinckley	Sandon	A. Johnson, Sandon						Silver, lead.
Jackson	Retallack	Jackson Mines, Ltd., Vancouver						Silver, zinc, lead.
Mammoth	New Denver	Western Exploration Co., Ltd., Silverton	150	150	150	July, 1935§	Table concentration; flotation	Silver, zinc, lead.
Molly Hughes	New Denver	Molly Hughes Mining Co., New Denver						Silver, gold, lead, zinc.
Galena Farm	Silverton	Galena Farm Cons. Mines, Ltd., Vancouver						Silver, lead.
Hewitt	Silverton Creek	Galena Farm Cons. Mines, Ltd., Vancouver						Silver, lead.
McAllister	Three Forks	Denver Mining Syndicate, New Denver						Silver, gold.
Noble Five	Cody	Noble Five Mines, Ltd., Nelson						Silver, lead, zinc.
Number One	Sandon	J. M. Harris, manager, Sandon						Silver, gold, lead, zinc.
Palmita	Alamo	C. Cunningham, Alamo						Silver, lead.
Queen Bess	Alamo	C. Cunningham, Alamo						Silver, lead, zinc.
Rio	Silverton	J. H. Pendry and W. R. George, New Denver						Silver, lead, zinc.
Silversmith	Sandon	Messrs. Stewart and Tattrie, leasers		150		1922‖	Table concentration; flotation	Silver, lead, zinc.
Slocan Monitor	Three Forks	Slocan Monitor Mines, Ltd., Nelson						Silver, lead.
Sovereign	Alamo	Cunningham Mines, Ltd., Alamo						Silver, lead, zinc.
Standard	Silverton	Western Exploration Co., Silverton						Silver, zinc, lead.
Victor	Sandon	E. Doney, lessee, Sandon						Silver, lead, zinc.
Wonderful	Sandon	W. D. Pengelly, Sandon						Silver, lead, zinc.
Arlington	Erie Creek	R. O. Oscarson, lessee, Erie						Gold, silver.
Athabasca	Nelson	Noble Five Mines, Ltd., Nelson	‖25			1920	Amalgamation; cyanidation	Gold, silver, lead.
Bayonne	Tye	Bayonne Cons. Mines, Ltd., Vancouver		50	50	Nov., 1936	Cyanidation	Gold, silver.
Black Cock	Ymir	Black Cock Mines, Ltd., Nelson						Gold, silver, lead, zinc.
Boulder City	Salmo	Clubine Comstock Gold Mines, Ltd., Nelson						Gold, silver.
California	Nelson	C. M. Stevenson *et al.*, leasers, Nelson						Gold, silver.
Catharine	Nelson	W. Jarvis, Nelson						Gold, silver, lead, zinc.

§ Inoperative since March, 1936. ‖ Idle at present.

TABLE XXI.—METALLIFEROUS MINES SHIPPING IN 1936—*Continued.*

Mine or Group.	Location of Mine or Mill.	Owner or Agent.	Rated Daily Capacity.		Operating at.	Date of First Operation.	Process.	Character of Ore.
			1935.	1936.				
			Tons.	Tons.	Tons.			
Gold Bank	Erie	Gold Bank Mining Syndicate, Trail	.....	.....	.....	.....	.....	Gold, silver.
Gold Fern	Nelson	Gold Fern Mines, Ltd., Nelson	.....	.....	.....	.....	.....	Gold, silver.
Granite	Taghum	Livingstone Mining Co., Ltd., Blewett	25	30	30	Sept., 1934	Amalgamation; concentration	Gold, silver.
Great Eastern	Nelson	Rolick Bros., Nelson	.....	.....	.....	.....	.....	Gold, silver.
Harriet	Erie	C. A. Cawley & Associates, Salmo	.....	.....	.....	.....	.....	Gold, silver.
Keystone	Erie	Dufferin Golds, Ltd., Vancouver	.....	.....	.....	.....	.....	Gold, silver, lead, zinc.
Kootenay Belle	Sheep Creek	Kootenay Belle Gold Mines, Ltd., Vancouver	50	100	100	Oct., 1934	Cyanidation	Gold, silver, lead, zinc.
Kootenay Ore Hill	Sheep Creek	Kootenay Ore Hill Gold Mines, Ltd., Vancouver.	.....	15	15	Dec., 1936	Concentration	Gold, silver, lead, zinc.
Lone Silver	Sheep Creek	S. A. Heidler *et al.*, Rossland	.....	.....	.....	.....	.....	Gold, silver, lead, zinc.
Michaely	Pend d'Oreille River	Michaely Silver Lead Mines, Ltd., Trail	.....	.....	.....	.....	.....	Gold, silver, lead, zinc.
Perrier	Nelson	J. Flagel, leaser, Nelson, from Perrier Gold Mines, Ltd., Nelson	.....	‖50	.....	1936	Amalgamation; flotation	Gold, silver, lead, zinc.
Relief-Arlington	Erie	Relief Arlington Mines, Ltd., Erie	70	75	75	1933	Amalgamation; flotation; cyanidation	Gold, silver, lead, zinc.
Reno	Sheep Creek	Reno Gold Mines, Ltd., Vancouver	120	120	120	Dec., 1932	Cyanidation	Gold, silver, lead, zinc.
Sheep Creek	Sheep Creek	Sheep Creek Gold Mines, Ltd., Vancouver	150	150	150	May, 1935	Cyanidation	Gold, silver.
Silver King	Nelson	J. Pavich & Co., Nelson	.....	.....	.....	.....	.....	Gold, silver, copper.
Venus-Juno	Nelson	G. T. Gormley, leaser, Nelson	.....	.....	.....	.....	.....	Gold, silver, lead.
Virginia	Nelson	J. W. Mulholland, Nelson	.....	.....	.....	.....	.....	Gold, silver.
Wesko	Ymir	Wesko Mines, Ltd., Nelson	.....	100	100	Oct., 1935	Flotation; cyanidation	Gold, silver, lead, zinc.
Wilcox	Ymir	Wilcox Mining Syndicate, Ymir	20	20	‡20	1933	Amalgamation	Gold, silver, lead, zinc.
Yankee Girl	Ymir	Ymir Yankee Girl Gold Mines, Ltd., Ymir	100	100	100	Dec., 1934	Cyanidation; flotation	Gold, silver, lead, zinc.
Ymir-Con	Ymir	Ymir Cons. Gold Mines, Ltd., Vancouver	100	100	‡100	July, 1935	Amalgamation; flotation	Gold, silver, lead, zinc.
Banker	Ainsworth	Leasers from H. Giegerich, Kaslo	.....	.....	.....	.....	.....	Silver, lead.
Banker	Ainsworth	Ainsworth Mines, Ltd., Ainsworth	.....	.....	.....	.....	.....	Silver, lead.
Casetto	Ainsworth	J. Casetto, Ainsworth	.....	.....	.....	.....	.....	Silver, lead.
Horsehoe	Ainsworth	H. Lind, Kaslo	.....	.....	.....	.....	.....	Silver, lead.
International	Ainsworth	International Mines, Inc., c/o J. Thronson, 502 Guardian Bldg., Portland, Oregon	.....	.....	.....	.....	.....	Silver, lead, zinc.
Krao	Keen Creek	Krao Mines, Ltd., Kaslo	.....	.....	.....	.....	.....	Silver, lead.
Whitewater	Retallack	O. Larsen, leaser from Whitewater Mines, Ltd., Kaslo	.....	.....	.....	.....	.....	Silver, lead.
Meridian	Camborne	Meridian Mining Co., Ltd., Vancouver	100	100	‖100	Jan., 1935	Flotation	Gold, silver.
Alleo	Albert Canyon	Alleo Silver Mines, Ltd., Vancouver	.....	.....	.....	.....	.....	Silver, gold, lead.
Cliff	Rossland	H. Hanson and F. Birch, Rossland	.....	.....	.....	.....	.....	Gold, silver.

‡ Intermittent. ‖ Idle at present.

			Tons.	Tons.	Tons.			
Evening Star	Rossland	J. Heap *et al.*, Rossland						Gold, silver.
Evening Star	Rossland	M. E. Norris, Burlington, Wash., U.S.A.						Gold, silver.
Golden Drip	Rossland	C. A. Ritchie, Rossland						Gold, silver.
Hattie	Rossland	S. Berg, Rossland						Gold, silver.
Iron Colt	Rossland	J. Penny *et al.*, Rossland						Gold, silver.
I.X.L.	Rossland	I.X.L. Lessors, Ltd., Rossland						Gold, silver.
Jumbo	Rossland	M. Slubowski, Rossland						Gold, silver.
Little Bess	Rossland	P. Storseric and W. Tartarchuk, Rossland						Gold, silver.
Midnight	Rossland	Midnight Syndicate, Rossland						Gold, silver.
Mighty Midas	Rossland	M. M. Butorac, Trail						Gold, silver.
Norway	Rossland	Norway Mining Co., Trail						Gold, silver.
O.K.	O.K. Mountain	O.K. Leasing Co., Rossland						Gold, silver.
Silverine	Rossland	A. O. Fried and M. Penny, Rossland						Gold, silver.
Ural	Rossland	C. J. Butorac, Trail						Gold, silver.
Velvet	Rossland	Velvet Gold Mining Co., Seattle, Wash.	50	100	‡100	Dec., 1935	Flotation	Gold, silver, copper.
Rossland properties	Rossland	Leasers from Cons. M. & S. Co., Trail						Gold, silver, copper.
Bralorne	Bridge River	Bralorne Mines, Ltd., Vancouver	450	450	450	Feb., 1932	Amalgamation; flotation	Gold, silver.
Minto	Bridge River	Minto Gold Mines, Ltd., Vancouver	50	120	85	Dec., 1934	Amalgamation; flotation	Gold, silver, lead.
Pioneer	Bridge River	Pioneer Gold Mines of B.C., Ltd., Vancouver	300	300	300	Feb., 1928	Cyanidation	Gold, silver.
Wayside	Bridge River	Wayside Cons. Gold Mines, Ltd., Vancouver	20	100	100	Nov., 1934	Flotation; cyanidation	Gold, silver.
Grange	Kelly Creek	Grange Mines, Ltd., Vancouver	50	50	¶	Jan., 1934	Amalgamation; flotation	Gold, silver.
Vidette	Savona	Vidette Gold Mines, Ltd., Vancouver	35	70	70	Dec., 1933	Flotation	Gold, silver, copper.
Anvil	Clayoquot	S. Knutsen *et al.*, Ceepeecee						Gold, silver.
Danzig	Nootka	Danzig Mines, Ltd., Seattle, Wash.						Gold, silver.
Gold Field	Ceepeecee	A. Bloom *et al.*, Ceepeecee						Gold, silver.
Van. Isle Group	Nootka	Nootka Gold Syndicate, Ceepeecee						Gold, silver.
Privateer	Ceepeecee	A. Bird, Ceepeecee						Gold, silver.
White Star	Ceepeecee	L. R. Brown, Ceepeecee						Gold, silver.
Home Gold	Verona	Home Gold Mining Co., Vancouver	25	18	18	Nov., 1934	Table concentration; flotation	Gold, silver.
Invermay-Annex	Hope	Invermay Annex Mining Co., Ltd., Vancouver						Silver, lead.
Havilah	Port Alberni	Havilah Gold Mines, Ltd., Victoria						Gold, silver.
Vancouver Island	Port Alberni	Vancouver Island Gold Mines, Ltd., Vancouver						Gold, silver.
Ashloo	Squamish	Ashloo Gold Mining Syndicate, Vancouver		25	25	Sept., 1936	Table concentration; flotation	Gold, silver, copper.
Britannia	Britannia Beach	Britannia Mining & Smelting Co., Ltd., Britannia Beach	5,000	5,000	3,600	Jan., 1923	Flotation	Copper, gold, silver; pyrite concentrate.
Golden Gate	Roy	Loughborough Gold Mines, Ltd., Vancouver						Gold, silver.
Old Bill Group	Lasqueti	Kurtzhals Bros., False Bay, Lasqueti Island						Gold, silver, copper.
Thurlow Gold	Thurlow Island	Northern M. & M. Co., Ltd., Vancouver	15	15	‡15	June, 1935	Table concentration	Gold, silver.

‡ Intermittent. ¶ Idle during 1936.

TABLE XXII.—Mining Companies employing an Average of Ten or more Men during 1936.

Shipping Mines.

Name of Mine or Company.	Days Operating.		Average Number of Men.		Tonnage.	
	Mine.	Mill.	Mine.	Mill.	Mined.	Shipped.
Welldun	248	305	6	6	4,425	4,425
Premier	365	365	284	32	192,442	192,442
Edye Pass	220	.....	12	.....	112	112
Surf Inlet	275	150	15	5	5,540	4,569
Surf Point	347	333	20	7	15,215	15,215
Granby	.....	.....	10	.....	.....	5,004
Easter	182	60	7	7	52,000	52,000
Cariboo Gold	282	282	214	13	51,634	51,760
Island Mountain	363	366	116	13	43,649	43,649
Homestake	49	20	8	2	1,103	1,103
Windpass	366	366	58	7	17,579	16,683
Nicola Mines & Metals	357	272	37	7	18,954	18,954
Fairview Amalgamated	187	213	19	5	12,960	12,960
Osoyoos Mines, Ltd.	366	291	20	7	7,500	7,110
Hedley Mascot	224	235	39	23	80,265	29,962
Kelowna Exploration	286	315	95	63	64,594	64,854
Union	.....	105	2	17	20,174	20,174
Yankee Boy	.....	.....	10	.....	389	389
Dentonia	308	138	43	6	11,612	11,612
Highland Bell	176	.....	18	.....	1,972	1,972
Sally	364	.....	10	.....	74	74
Wellington	315	.....	19	.....	701	701
Sullivan	286	318	621	234	1,910,619	1,901,476
Mammoth	74	77	28	4	9,088	9,485
Bayonne	213	59	39	2	2,666	2,666
Boulder City	361	.....	14	.....	703	703
Granite	288	168	16	2	1,414	1,414
Kootenay Belle	328	331	55	7	21,864	15,508
Kootenay Ore Hill	358	123	25	1	427	427
Relief Arlington	366	336	71	15	34,776	25,462
Reno	366	366	99	21	42,751	42,705
Wesko	346	69	40	4	6,043	6,043
Ymir Yankee Girl	314	352	85	19	43,149	43,378
Ymir Consolidated	348	215	21	4	11,816	11,816
Sheep Creek Consolidated	366	366	91	10	54,967	54,967
Meridian	280	280	39	8	27,273	27,273
Allco	365	.....	10	1	99	99
Bralorne	366	366	302	18	167,264	167,264
Minto	345	347	50	12	29,392	29,271
Pioneer	365	365	274	27	154,881	145,847
Wayside	308	335	38	9	38,000	37,535
Vidette	338	338	79	6	12,202	12,352
Ashloo Gold Mines Syndicate	177	177	8	4	2,774	2,774
Britannia	336	665	683	69	1,311,835	1,311,835

TABLE XXII.—MINING COMPANIES EMPLOYING AN AVERAGE OF TEN OR MORE MEN DURING 1936—*Continued.*

Non-shipping Mines.

Name of Mine or Company.	Days Operating.		Average Number of Men.		Tonnage.	
	Mine.	Mill.	Mine.	Mill.	Mined.	Shipped.
Polaris-Taku	242	.....	27	.....	.....	.....
Big Missouri	365	.....	171	.....	.....	.....
Gold Mountain	365	.....	21	.....	.....	.....
Hedley Amalgamated	365	.....	26	.....	.....	.....
Base Metals Corporation	305	.....	30	.....	.....	.....
Euphrates	180	.....	10	.....	.....	.....
Gold Belt	350	.....	36	.....	.....	.....
Salmo-Malartic	365	.....	14	.....	.....	.....
Wisconsin	209	.....	12	.....	.....	.....
B.R.X. (1935) Consolidated	309	.....	22	.....	.....	.....
Federal Gold	198	.....	11	.....	.....	.....
Pacific Eastern	365	.....	41	.....	.....	.....
Pilot Gold	.....	.....	10	.....	.....	.....
Reliance Gold	.....	.....	10	.....	.....	.....
B.C. Nickel Mines, Ltd.	314	.....	15	.....	.....	.....

SYNOPSIS OF MINING LAWS OF B.C.

Mineral Act and Placer-mining Act.

The mining laws of British Columbia are very liberal in their nature and compare favourably with those of any other part of the world. The terms under which both lode and placer claims and placer leaseholds are held are such that a prospector is greatly encouraged in his work, and the titles, especially for mineral claims and placer-mining leaseholds, are perfect. The fees required to be paid are as small as possible, consistent with a proper administration of the mining industry, and are generally lower than those commonly imposed elsewhere. Provision is also made for the formation of mining partnerships practically without expense, and a party of miners is enabled to take advantage of these sections of the Acts so that such miners may work their claims jointly.

Placer-mining leases are granted for a period of twenty years and are approximately 80 acres in size. On a lode claim of 51 acres the expenditure of $500 in work, which may be spread over five years, is required to obtain a Crown grant, and surface rights are obtainable at a small figure, in no case exceeding $5 per acre.

The following synopsis of the mining laws will be found sufficient to enable the miner or intending investor to obtain a general knowledge of their scope and requirements; for particulars, however, the reader is referred to the Acts relating to mining, which may be obtained from any Mining Recorder, or from the Department of Mines or the King's Printer, Victoria, B.C.

Free Miners' Certificates.

Any person over the age of 18, and any joint-stock company, may obtain a free miner's certificate on payment of the required fee.

The fee to an individual for a free miner's certificate is $5 for one year. To a joint-stock company having a capital of $100,000, or less, the fee for a year is $50; if capitalized beyond this, the fee is $100.

The free miners' certificates run from date of issue and expire on the 31st day of May next after its date, or some subsequent 31st day of May (that is to say, a certificate may be taken out a year or more in advance if desired). Certificates may be obtained for any part of a year, terminating on May 31st, for a proportionately less fee.

The possession of this certificate entitles the holder to enter upon all lands of the Crown, and upon any other lands on which the right to so enter is not specially reserved, for the purpose of prospecting for minerals, locating claims, and mining.

A free miner can only hold, by location, one mineral claim on the same vein or lode, but may acquire others by purchase. Under the "Placer-mining Act," a free miner may locate one placer claim or leasehold in his own name and one placer claim or leasehold for each of two free miners for whom he acts as agent, on any separate creek, river-bed, bar or dry diggings. Other placer claims or leaseholds may be acquired by purchase.

In the event of a free miner allowing his certificate to lapse, his mining property (if not Crown-granted) reverts to the Crown (subject to the conditions set out in the next succeeding paragraph), but where other free miners are interested as partners or co-owners the interest of the defaulter becomes vested in the continuing co-owners or partners *pro rata*, according to their interests.

Six months' extension of time within which to revive title in mining property which has been forfeited through the lapse of a free miner's certificate is allowed. This privilege is given only if the holder of the property obtains a special free miner's certificate within six months after the 31st of May on which his ordinary certificate lapsed. The fee for this special certificate in the case of a person is $15 and in that of a company $300.

It is not necessary for a shareholder, as such, in an incorporated mining company to be the holder of a free miner's certificate.

Mineral Claims.

Mineral claims are located and held under the provisions of the "Mineral Act."

A mineral claim is a piece of land not exceeding in area fifty-one and sixty-five one-hundredths acres. The angles must be right angles unless the boundaries, or one of them, are the same as those of a previously recorded claim.

No special privileges are allowed for the discovery of new mineral claims or districts.

A mineral claim is located by erecting three "legal posts," which are stakes having a height of not less than 4 feet above ground and squared 4 inches at least on each face for not less than a foot from the top. A tree-stump so cut and squared also constitutes a legal post. A cairn of stones not less than 4 feet in height and not less than 1 foot in diameter 4 feet above the ground may also be used as a legal post.

The "discovery post" is placed at the point where the mineral in place is discovered.

Nos. 1 and 2 posts are placed as near as possible on the line of the ledge or vein, shown by the discovery post, and mark the boundaries of the claim. Upon each of these three posts must be written the name of the claim, the name of the locator, and the date of location. On No. 1 post, in addition, the following must be written: "Initial post. Direction of Post No. 2 [*giving approximate compass bearing*] ——— feet of this claim lie on the right and ——— feet on the left of the line from No. 1 to No. 2 posts."

The location-line between Nos. 1 and 2 posts must be distinctly marked—in a timbered locality by blazing trees and cutting underbrush, and in bare country by monuments of earth or rock not less than 2 feet in diameter at the base, and at least 2 feet high—so that the line can be distinctly seen.

Mineral claims must be recorded in the Mining Recorder's office for the mining division in which they are situate within fifteen days from the date of location, one day extra being allowed for each 10 miles of distance from the recording office after the first 10 miles. If a claim is not recorded in time it is deemed abandoned and open for relocation, but if the original locator wishes to relocate he can only do so by permission of the Gold Commissioner of the district and upon the payment of a fee of $10. This applies also to a claim abandoned for any reason whatever.

Mineral claims are, until the Crown grant is issued, held practically on a yearly lease, a condition of which is that during such year assessment-work be performed on the same to the value of at least $100, or a payment of such sum be made to the Mining Recorder. Such assessments must be recorded before the expiration of the year, or the claim is deemed abandoned. If, however, the required assessment-work has been performed within the year, but not recorded within that time, a free miner may, within thirty days thereafter, record such assessment-work upon payment of an additional fee of $10. The actual cost of the survey of a mineral claim, to an amount not exceeding $100, may also be recorded as assessment-work. If, during any year, work is done to a greater extent than the required $100, any further sum of $100—but not less—may be recorded and counted as further assessments; such excess work must be recorded during the year in which it is performed. All work done on a mineral claim between the time of its location and recording may be counted as work done during the first period of one year from the recording. As soon as assessment-work to the extent of $500 is recorded and a survey made of the claim, the owner of a mineral claim is entitled to a Crown grant on payment of a fee of $25, and giving the necessary notices required by the Act. Liberal provisions are also made in the Act for obtaining mill-sites and other facilities in the way of workings and drains for the better working of claims.

Placer Claims.

Placer-mining is governed by the "Placer-mining Act," and by the interpretation clause its scope is defined as "the mining of any natural stratum or bed of earth, gravel, or cement mined for gold or other precious minerals or stones." Placer claims are of four classes, as follows:—

"'Creek diggings': any mine in the bed of any stream or ravine:

"'Bar diggings': any mine between high- and low-water marks on a river, lake, or other large body of water:

"'Dry diggings': any mine over which water never extends:

"'Precious-stone diggings': any deposit of precious stones, whether in veins, beds, or gravel deposits."

The following provisions as to extent of the various classes of claims are made by the Act:—

"In 'creek diggings' a claim shall be two hundred and fifty feet long, measured in the direction of the general course of the stream, and shall extend in width one thousand feet, measured from the general course of the stream five hundred feet on either side of the centre thereof:

"In 'bar diggings' a claim shall be:—

"(*a.*) A piece of land not exceeding two hundred and fifty feet square on any bar which is covered at high water; or

"(*b.*) A strip of land two hundred and fifty feet long at high-water mark, and in width extending from high-water mark to extreme low-water mark:

"In 'dry diggings' a claim shall be two hundred and fifty feet square."

The following provision is made for new discoveries of placer-mining ground:—

"If any free miner, or party of free miners, discovers a new locality for the prosecution of placer-mining and such discovery be established to the satisfaction of the Gold Commissioner, placer claims of the following sizes shall be allowed to such discoverers, namely:—

"To one discoverer, one claim..... 600 feet in length;

"To a party of two discoverers, two claims amounting together to .....1,000 feet in length;

"And to each member of a party beyond two in number, a claim of the ordinary size only.

"The width of such claims shall be the same as ordinary placer claims of the same class: Provided that where a discovery claim has been established in any locality no further discovery shall be allowed within five miles therefrom, measured along the watercourses."

Every placer claim shall be as nearly as possible rectangular in form, and marked by four legal posts at the corners thereof, firmly fixed in the ground. On each of such posts shall be written the name of the locator, the number and date of issue of his free miner's certificate, the date of the location, and the name given to the claim. In timbered localities boundary-lines of a placer claim shall be blazed so that the posts can be distinctly seen, underbrush cut, and the locator shall also erect legal posts not more than 125 feet apart on all boundary-lines. In localities where there is no timber or underbrush, monuments of earth and rock, not less than 2 feet high and 2 feet in diameter at base, may be erected in lieu of the last-mentioned legal posts, but not in the case of the four legal posts marking the corners of the claim.

A placer claim must be recorded in the office of the Mining Recorder for the mining division within which the same is situate, within fifteen days after the location thereof, if located within 10 miles of the office of the Mining Recorder by the most direct means of travel. One additional day shall be allowed for every 10 miles additional or fraction thereof. The number of days shall be counted inclusive of the days upon which such location was made, but exclusive of the day of application for record. The application for such record shall be under oath and in the form set out in the Schedule to the Act. A claim which shall not have been recorded within the prescribed period shall be deemed to have been abandoned.

To hold a placer claim for more than one year it must be rerecorded before the expiration of the record or rerecord.

A placer claim must be worked by the owner, or some one on his behalf, continuously, as far as practicable, during working-hours. If work is discontinued for a period of seventy-two hours, except during the close season, lay-over, leave of absence, sickness, or for some other reason to the satisfaction of the Gold Commissioner, the claim is deemed abandoned.

Lay-overs are declared by the Gold Commissioner upon proof being given to him that the supply of water is insufficient to work the claim. Under similar circumstances he has also the power to declare a close season, by notice in writing and published in the Gazette, for all or any claims in his district. Tunnel and drain licences are also granted by him on the person applying giving security for any damage that may arise. Grants of right-of-way for the construction of tunnels or drains across other claims are also granted on payment of a fee of $25, the owner of the claims crossed having the right for tolls, etc., on the tunnel or drain which may be constructed. These tolls, however, are, so far as the amount goes, under the discretion of the Gold Commissioner.

Co-owners and Partnerships.

In both the "Mineral" and "Placer-mining" Acts provision is made for the formation of mining partnerships, both of a general and limited liability character. These are extensively taken advantage of and have proved very satisfactory in their working. Should a co-owner fail or refuse to contribute his proportion of the expenditure required as assessment-work on a claim he may be "advertised out," and his interest in the claim shall become vested in his co-owners who have made the required expenditure, *pro rata* according to their former interests.

It should not be forgotten that if any co-owner permits his free miner's certificate to lapse, the title of his associates is not prejudiced, but his interest reverts to the remaining co-owners; provided that said co-owner has not taken advantage of the six months' period of grace allowed for the taking-out of a special free miner's certificate, thus reviving the title to his interest.

Placer-mining Leases.

Leases of unoccupied Crown lands approximately 80 acres in extent may be granted by the Gold Commissioner of the district after location has been made by staking along a "location-line" not more than one-half a mile (2,640 feet) in length. In this line one bend, or change of direction, is permitted. Where a straight line is followed two posts only are necessary—namely, an "initial post" and a "final post." Where there is a change of direction a legal post must be placed to mark the point of the said change. The leasehold is allowed a width not in excess of one-quarter mile (1,320 feet), and the locator, both on his "initial post" and in his notice of intention to apply, which is posted at the office of the Mining Recorder, is required to state how many feet are included in the location to the right and how many feet to the left of the location-line.

That section of the Act dealing with the staking of placer-mining leases follows:—

"105A. (1.) For the purpose of locating a placer leasehold, a line to be known as the 'location-line' shall be marked on the ground by placing a legal post at each end, one post to be known as the 'Initial post' and the other as the 'Final post.' The direction of the location-line may change at not more than one point throughout its length, and an intermediate legal post shall be placed at the point at which the direction changes. The total length of the location-line, following its change of direction (if any), shall not exceed two thousand six hundred and forty feet.

"(2.) Upon the initial post and the final post shall be written the words 'Initial Post' and 'Final Post' respectively, together with the name of the locator and the date of the location. On the initial post shall also be written the approximate compass-bearing of the final post, and a statement of the number of feet of the leasehold lying on the right and on the left of the location-line, as viewed from the initial post, not exceeding in the aggregate a width of thirteen hundred and twenty feet, thus: 'Direction of Final Post, , feet of this claim lie on the right and feet on the left of the location-line.' In addition to the foregoing, where there is a change of direction in the location-line as marked on the ground, the number '1' shall be written on the initial post; the number '2' shall be written on the intermediate post; and the number '3' shall be written on the final post There also shall be affixed to the initial post a notice to the following effect, namely: 'Application will be made under the "Placer Mining Act" for a lease of the ground within this location.'

"(3.) The location-line shall at the time of location be marked between the legal posts throughout its length so that it can be distinctly seen; in a timbered locality, by blazing trees and cutting underbrush, and in a locality where there is neither timber nor underbrush, by placing legal posts or monuments of earth or stones not less than two feet high and not less than two feet in diameter at the base, so that the location-line can be distinctly seen.

"(4.) Where, from the nature or shape of the surface of the ground, it is impracticable to mark the location-line of a leasehold as provided by this section, the leasehold may be located by placing legal posts as witness-posts, as near as possible to the location-line, and writing on each witness-post the distance and compass-bearing of some designated point on the location-line from the witness-post; and the distances and compass-bearing so written on the witness-posts shall be set out in the application for the lease and in any lease granted thereon.

"(5.) The locator shall, within thirty days after the date of the location, post a notice in Form 1 in the office of the Mining Recorder, which notice shall set out:—

"(*a.*) The name of the intending applicant or each applicant if more than one, and the numbers of their free miners' certificates:

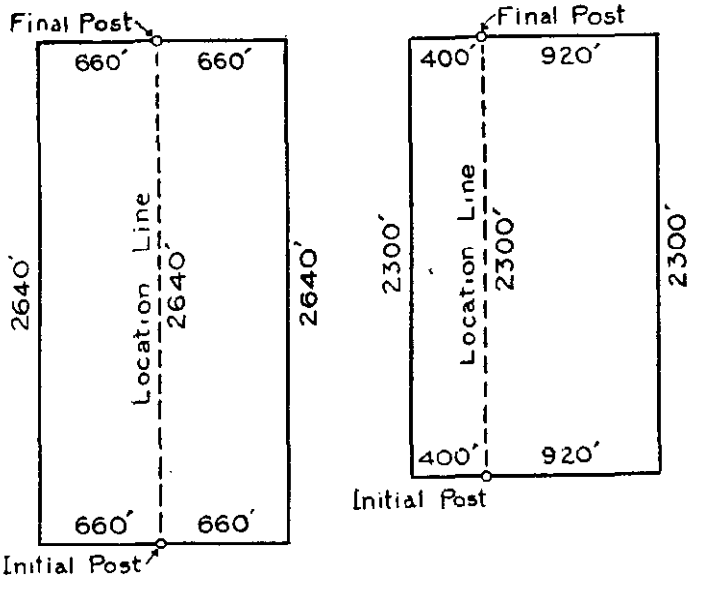
"(*b.*) The date of the location:

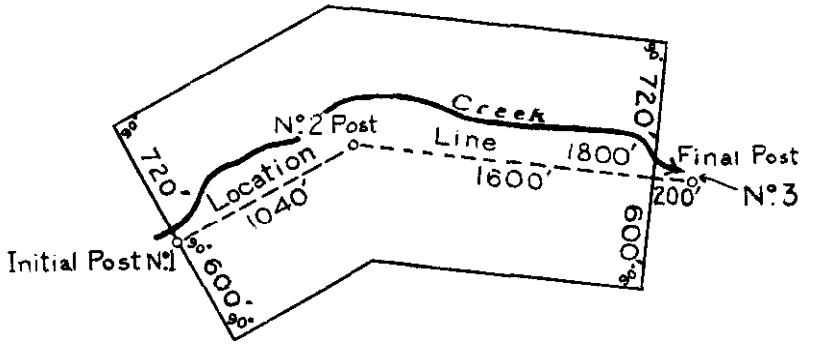
"(*c.*) The number of feet lying to the right and left of the location-line, and the approximate area or size of the ground.

The words written on the initial post and final post shall be set out in full in the notice; and as accurate a description as possible of the ground to be acquired shall be given, having special reference to any prior locations it may join, and the general locality of the ground to be acquired.

EXAMPLES OF VARIOUS METHODS OF LAYING OUT PLACER LEASEHOLDS.

Showing Areas secured with Location-lines of Various Lengths.





"(6.) The location and area of the placer leasehold shall be determined by establishing its end lines running from or through the initial post and from or through the final post, at right angles to the course of the location-line at those posts, respectively; and by establishing its side-line parallel to the course or courses of the location-line, and distant one thousand three hundred and twenty feet from each other."

Another provision is that there must be affixed to the "initial post" and to the "final post" a numbered metal identification tag furnished by the Mining Recorder with each free miner's

certificate issued. These tags may be attached to the posts, or placed in a container within a cairn, either at the time of location or some time during the succeeding year, but must be so placed before the Mining Recorder will grant the first certificate of work in respect of the leasehold.

The annual rental on a placer-mining lease is $30, and the amount to be expended annually on development-work is $250.

Dredging leases on rivers for 5 miles below low-water mark are also granted. Section 122 of the Act establishes a definite method of staking such mining ground. Authority also has been given for the granting of placer-mining leases for dredging purposes in locations other than has been defined.

For more detailed information the reader is referred to the complete " Placer-mining Act," which may be obtained from the King's Printer, Victoria, B.C.

Table of Fees, Mineral Act and Placer-mining Act.

Individual free miner's certificate, annual fee	$5.00
Company free miner's certificate (capital $100,000 or less), annual fee	50.00
Company free miner's certificate (capital over $100,000), annual fee	100.00
Recording mineral or placer claim	2.50
Recording certificate of work, mineral claim	2.50
Rerecord of placer claim	2.50
Recording lay-over	2.50
Recording abandonment, mineral claim	10.00
Recording abandonment, placer claim	2.50
Recording any affidavit under three folios	2.50
Per folio over three, in addition	.30
Records in " Records of Conveyances," same as affidavits.	
Filing documents, " Mineral Act "	.25
Filing documents, " Placer-mining Act "	1.00
Recording certificate of work, placer-mining lease	2.50
For Crown grant of mineral rights under " Mineral Act "	25.00
For Crown grant of surface rights of mineral claim under " Mineral Act "	10.00
For every lease under " Placer-mining Act "	5.00

Provisional Free Miners' Certificates (Placer) Act.

This Act was passed at the 1932 session of the Provincial Legislature and provides for the issuance of " provisional free miners' certificates " for the locating, recording, representing, and working of placer claims of a size, and according to the terms, and in the manner set out in Parts II. and III. of the " Placer-mining Act." Any person over 18 years of age who has resided in the Province continuously for a period of not less than six months prior to date of his application may, on application accompanied by a statutory declaration or other satisfactory evidence as to his age and period of residence in the Province, obtain from any Gold Commissioner or Mining Recorder a provisional free miner's certificate. No fees are payable in respect of such certificate, and it abolishes the fees payable in respect of the recording or rerecording of placer claims, but no record or rerecord of a claim shall be granted for a longer period than one year without the payment of fees. It should be pointed out that the provisional free miner's certificate does not carry the privileges of an ordinary free miner's certificate as to the staking and working of placer-mining leases or mineral claims.

An amendment passed at the 1933 session of the Legislative Assembly gives the Lieutenant-Governor in Council, as a means of unemployment relief, power to make provision for the establishment, equipment, maintenance, and operation of one or more placer training camps at suitable locations, at which unemployed persons who hold provisional free miners' certificates and are British subjects may acquire knowledge and training in the art of placer-mining and may be afforded gainful work in the recovery of minerals by placer-mining. Reserves for the location of such camps shall not exceed one mile in length by one-half a mile in width, and the right is given to enter into agreements with private holders under the Act for the development of their ground by means of unemployment relief camps.

Mines Development Act.

When it is shown to the satisfaction of the Minister of Mines that ore-bodies exist in quantity and of commercial value sufficient to warrant the expenditure of public moneys, the Minister of Mines may authorize the expenditure of so much of the public money as may be required for the construction, reconstruction, or repair of trails, roads, and bridges to facilitate the operation and development of such mineral or placer claims.

Furthermore, the Minister of Mines may authorize the expenditure of public money towards the building or repairing of trails and bridges in or to any mineral district for the purpose of facilitating the exploration of the mineral resources of the district, such expenditure not to exceed 50 per cent. of the cost of the work. If such roads, trails, or bridges have been built by any person or company having mining interests in the district, the Minister of Mines may refund to such person a portion, not exceeding 50 per cent. of the cost of such construction.

Mineral Survey and Development Act.

Part I.—Mineral Survey.

A mineral survey of the Province has been established, to be carried on continuously and records thereof kept.

For this purpose the Province has been divided into Mineral Survey Districts, and there are five Resident Engineers who, with such assistance as is necessary, devote their whole time to carrying out the provisions of this Act, reporting direct to the Minister.

Part II.—Aid to Prospectors.

The Resident Engineer in each district shall aid prospectors, as far as practicable:—

(*a.*) By giving information as to mineral indications and as to ground open for location as mineral claims or placer claims as a result of knowledge gained during the carrying-out of the mineral survey of his district:

(*b.*) By examining samples and applying such tests as may be possible on the ground or in his office and advising as to the nature of any mineral and as to the best available methods of analysis, sampling, assay, and test:

(*c.*) By forwarding samples to the Minister of Mines for further examination and tests whenever in his opinion such course is necessary or expedient:

(*d.*) By reporting to the Minister of Mines the location and approximate cost of such roads, trails, and bridges as in his opinion are reasonably necessary in order to render possible the development of any mineral resoures; and

(*e.*) Generally, by giving such advice, information, and directions as may be of assistance to miners and prospectors within his district.

Part III.—Protection of Wage-earners.

1. Every person giving or making a working bond or a lease, with or without any option for sale, of any mining property shall insert therein a provision that during the currency of the bond or lease all free miners and wage-earners employed on or about the mining property shall be paid their wages semi-monthly, and shall demand and receive a letter, to be procured by the holder of the bond or lease from a Gold Commissioner or Government Agent or Mining Recorder, stating that security for such wages has been given pursuant to this section, otherwise the person giving or making the bond or lease shall be under personal liability to pay all such wages.

2. Every person taking a right or option to work or purchase any mining property shall furnish to the nearest Gold Commissioner, or Government Agent, or Mining Recorder adequate security from time to time for the payment semi-monthly of the wages of all free miners and wage-earners employed on or about the mining property, on the terms that every such security shall be forthwith realized and payment of wages made upon any default; and every Gold Commissioner, Government Agent, and Mining Recorder shall have full power and authority to realize upon the security lodged with him so as to make payment of any wages in default, and shall make payment thereof up to the amount realized.

PART IV.—PROTECTION OF INVESTORS.

Each Resident Engineer shall, upon receiving notice of any advertised or solicited sale of shares in any company or in any claim or mine or mineral property whatsoever, upon statements or terms not in accordance with actual facts and conditions, notify the Minister of Mines, who, upon investigation, may, if found necessary, give such notice, either personal or public, as may be necessary to prevent any injury to investors; and every notice given under this section by the Minister of Mines shall be absolutely privileged.

Iron and Steel Bounties Act, 1929.

The Lieutenant-Governor in Council may enter into an agreement with any person whereby the Crown will pay to that person, out of the Consolidated Revenue Fund, bounties on pig-iron and steel shapes when manufactured within the Province, as follows:—

(*a.*) In respect of pig-iron manufactured from ore, on the proportion produced from ore mined in the Province, a bounty not to exceed three dollars per ton of two thousand pounds:

(*b.*) In respect of pig-iron manufactured from ore, on the proportion produced from ore mined outside the Province, a bounty not to exceed one dollar and fifty cents per ton of two thousand pounds:

(*c.*) In respect of steel shapes of commercial utility manufactured in the Province, a bounty not to exceed one dollar per ton of two thousand pounds.

Bounty, as on pig-iron under this Act, may be paid upon the molten iron from ore which in the electric furnace, Bessemer or other furnace, enters into the manufacture of steel by the process employed in such furnace; the weight of such iron to be ascertained from the weight of the steel so manufactured.

Bounty on steel shapes under this Act shall be paid only upon such steel shapes as are manufactured in a rolling-mill having a rated productive capacity per annum of at least twenty thousand tons of two thousand pounds per ton.

Phosphate-mining Act, 1925.

This Act takes the mineral tricalcium phosphate out of the "Mineral Act" for the purpose of administration. This is done to make possible the staking of phosphate claims one mile square in area.

Any person desirous of securing a licence to prospect for phosphate is required to stake the land he may wish to acquire and work; and after such staking shall post in the office of the Gold Commissioner for the mining division in which the land is situated a notice of his intention to apply for a licence. Then the applicant is required to make application in writing to such Gold Commissioner for a prospecting licence over the land for any term not exceeding one year. The Gold Commissioner shall forward this application to the Hon. the Minister of Mines, who may grant to the applicant a prospecting licence. Application shall be accompanied by a licence fee of $100. The land to be acquired shall be of a rectangular shape and shall not exceed 640 acres for each licence, measuring 80 chains by 80 chains, and boundary-lines shall be run true north and south and true east and west. A renewal of the licence may be obtained for a second period of one year upon payment of further licence fee of $100, and furnishing proof that he has explored for phosphate and has expended not less than $50 in such exploration-work. An extension of the term for a third period of one year may be granted upon like conditions and terms. Provision is made for the payment of $150 in cash in lieu of exploration-work. The cost of the survey of the land, not being less than $150, can be counted as exploration-work. If during any one year work is done to a greater extent than the required $50—but not less—same may be applied as work for any subsequent year that the licence remains in force.

The Lieutenant-Governor in Council may grant a lease of the land covered by a prospecting licence to any licensee who during the existence of his licence, or within thirty days following the expiry of same, gives satisfactory evidence that he has discovered phosphate on such lands. He shall at the same time pay a sum sufficient to cover the first annual rental and also shall have expended not less than $50 per licence in exploration-work during the term of the last renewal licence or tender in lieu thereof the sum of $50 per licence. Such

lease shall be granted for a term of five years, renewable for three years, and for a further three years after the expiry of the first renewal. A lease shall not be issued until the land has been surveyed by an authorized land surveyor. An annual rental rate of 15 cents per acre shall be payable under said lease.

The lease provides for the expenditure of not less than $100 per annum in the development of a mine, or the payment of $100 in lieu of such development-work. Excess work done in any one year may be applied as work to subsequent years. Provision is also made for the purchase of phosphate-mining rights.

Metalliferous Mines Regulation Act.

At the 1935 session of the Provincial Legislature " An Act to amend and consolidate the Enactments regulating the Working of Metalliferous Mines, Quarries, and Metallurgical Works " was passed. This Act is known as the " Metalliferous Mines Regulation Act," and, in its general tone, its clear purpose is to maintain the highest standard in respect of safety and of healthy conditions, both on the surface and underground in mining operations. The idea is to not only assure, as far as practicable, the protection of workmen against injury, but to establish those conditions best calculated to safeguard the health of the men employed. The Act also provides for the drafting of regulations, if such are found necessary, for the protection of men who are working under conditions which may lead to pulmonary disability.

This Act may be divided into six parts, as follows:—

(1.) Administration:
(2.) Duties of owners, managers, and others:
(3.) Special Rules for protection of miners:
(4.) General Rules, having reference to: (*a*) Employees; (*b*) Ventilation; (*c*) Explosives and blasting; (*d*) Fire-protection; (*e*) Connection between mines; (*f*) Mine signals; (*g*) Aid to injured; (*h*) Prevention of dust; (*i*) Handling of water; (*j*) Sanitation; (*k*) Protection of working-places, shafts, winzes, raises, etc.; (*l*) Ladder-ways; (*m*) Shaft equipment and operation; (*n*) Testing of brakes; (*o*) Haulage; (*p*) Protection from machinery; (*q*) Electrical installations:
(5.) General Rules for quarries:
(6.) Supplemental.

SUMMARY OF ACTS SPECIALLY RELATING TO MINING.

(The complete Acts may be obtained from the King's Printer, Victoria, B.C.)

Mining Licences under the Coal and Petroleum Act.

Any person desiring to prospect for coal, petroleum, or natural gas upon any unsurveyed unreserved lands in which these resources are held by the Crown may acquire a licence to do so over a rectangular block of land not exceeding 640 acres, of which the boundaries shall run due north and south and east and west, and no side shall exceed 80 chains (1 mile) in length. Before entering into possession of the said lands he shall place at the corner of such block a legal stake, or initial post, and shall inscribe thereon his name and the angle represented by such post, thus: "A. B.'s N.E. corner," or as the case may be, and shall post in a conspicuous place upon the said land, and also in the Government office of the land recording district, notice of his intention to apply, as well as publishing the same in the B.C. Gazette and local newspaper once each week for four consecutive weeks. If the area applied for is surveyed no staking is required, but the same procedure with regard to advertising notice of intention to apply is necessary.

The application for said licence shall be in writing, in duplicate, and shall contain the best written description possible, with a diagram of the land sought to be acquired, and shall be accompanied with a fee of $100. The application shall be made to the Commissioner of Lands for the district, and by him forwarded to the Minister of Lands, who will grant such licence—provided no reasons arise to the contrary—for a period not to exceed one year, and at the expiration of the first year an extension of such licence may be granted for a second or third year at a fee of $100.

Where coal is discovered during the existence of licence or within thirty days after expiration, the land held under licence, having been surveyed and licence conditions fulfilled, may be leased for five years at rental of 15 cents an acre, subject to renewals for five successive periods of three years each, renewal fee being $100 for each lease, in addition to annual rental.

Lessees, on showing continuous work has been done and reasonable expenditure made for development, may, after carrying out the provisions of the lease, purchase at $20 per acre where surface is available, or $15 per acre for under-surface rights where surface is not available. Lands under the sea may be purchased at $15 per acre. Provided also that, in addition to the rental or purchase price, there shall be paid to the Government as a royalty 2½ cents a barrel (35 imperial gallons) of crude petroleum raised or gotten from such land. (*See* chapter 162, R.S.B.C. 1924.)

Taxation Act.

A preliminary note is essential to the understanding of this Act. As the law has stood, a Crown-granted mineral claim on which taxes were in arrears for a number of years was offered for sale by the Government at a *tax* sale, with arrears of taxes plus interest and charges and Crown-grant fees as an upset price. If no sale was made the property remained in the hands of the Assessor until desired by some one, when it could only be purchased by tender. It was *not open to location under the "Mineral Act" and a prospector had no protection, and to* relieve the situation an amending Act was passed.

Under the amended Act such reverted Crown-granted mineral claim may be obtained by any person under a lease for one year upon payment of $25, and a renewal of such lease may be granted upon payment of further $25 for a further period of one year, but no longer. During the period of such lease the lessee has the right to enter, prospect, and mine on such mineral claim, save for coal, petroleum, and natural gas, and during such time the lessee has the option to purchase such Crown-granted mineral claim upon payment of all taxes, costs, and interest which remained due and unpaid on such claim on the date of its forfeiture to the Crown, together with an amount equal to all taxes and interest which, except for its forfeiture to the Crown, would have been payable in respect thereof from the date of the lease to the date of application for a Crown grant. If, however, the lessee establishes to the satisfaction of the Gold Commissioner that he has expended upon the claim in mining-development work a sum of not less than $200 a year during the continuance of the lease, then the payment of the sum in

respect of taxes and penalties from the date of the lease to the date of application for a Crown grant shall not be required. Provision also is made for the grouping of adjoining claims, not exceeding eight in number, and the performing on one of such claims mining-development work for all of the claims.

A person may obtain a lease, or interest in a lease, of eight such claims in the same mining division.

Such leases are not transferable and are subject to the rights any person may already hold to any portion of the surface of such Crown-granted mineral claim.

Taxation of Mines.

Crown-granted mineral claims are subject to a tax of 25 cents per acre. The tax becomes due on April 1st in each year, and if unpaid on the following June 30th is deemed to be delinquent.

All mines, other than coal, are subject to an output tax (payable quarterly) of 2 per cent. on gross value of ore, less cost of transportation from mine to reduction-works and the cost of treating same at reduction-works or on the mining premises.

Any such mine, not realizing on ore shipments a market value of $5,000 in any one year, is entitled to a refund of the output tax paid.

All mines are subject to a tax upon income, subject to the exemptions and allowances given in the " Income Tax Act "; provided, in the case of those mines paying an output tax, that an income tax is only collected if such tax prove greater than the output tax, and the output tax is then regarded as part payment of the income tax.

In addition to the ordinary working expenses, mines are allowed to deduct from their income a charge for:—

(1.) Development—being such proportion of this capital expenditure as is ascertained to be chargeable to the year's operation:
(2.) Depreciation of buildings and plant:
(3.) Depletion—being such proportion of the capital cost of the mine as, being a wasting asset, is ascertained to be chargeable to the year's operation.

The above-mentioned charges are allowable at the discretion of the Minister of Finance, subject, however, to an appeal to the Lieutenant-Governor in Council.

The rate of income tax varies from 1 per cent. up to a maximum of 10 per cent. on incomes of $19,000 and over.

Coal is subject to a tax of 10 cents per ton of 2,240 lb., except coal shipped to coke-ovens within the Province. Tax payable monthly.

Coke is subject to a tax of 10 cents per ton of 2,240 lb., except in respect of coke produced from coal upon which this tax has already been paid. Tax payable monthly.

Coal land from which coal is being mined (Class A) is taxed at 1 per cent. upon the assessed value, in addition to any other tax.

Unworked coal land, known as " Coal Land, Class B," is subject to a tax of 2 per cent. upon the assessed value.

For further particulars *see* the " Taxation Act," also the " Public Schools Act," which are obtainable from the King's Printer, Victoria, B.C.

ASSAY OFFICE.

BY

D. E. WHITTAKER.

During the year 1936 there were made by the staff in the Government Assay Office 7,609 assays or quantitative determinations and 287 analyses; of these the majority were for the Department of Mines or for the other departments, for which no fees were received.

The fees collected by the office were as follows:—

Fees for analyses	$32.50
Fees for assaying	40.50
Fees for assayers' examinations	210.00
Total cash receipts	$283.00

Determinations and examinations made for other Government departments, for which no fees were collected:—

Attorney-General's Department	$793.00
Agricultural Department	2,203.00
Board of Health	740.00
Other departments	455.00
Treasury	1,470.00
	$5,661.00
Value of work done outside of Mines Department work	$5,944.00

One thousand four hundred and seventy lots of gold were received from the Gold Commissioners, who are purchasing amounts up to 2 oz. to aid the prospector in disposing of his gold.

FREE DETERMINATIONS.

In addition to the above quantitative work, 952 qualitative determinations, or tests, were made in connection with the identification and classification of rocks or minerals sent to the Assay Office for a report; for these no fees were charged, as it is the established custom of the Department to examine and test qualitatively, without charge, samples of minerals sent in from any part of the Province, and to give a report on the same. This has been done for the purpose of encouraging the search for new or rare minerals and ores, and to assist prospectors and others in the discovery of new mining districts, by enabling them to have determined, free of cost, the nature and probable value of any rock they may find. In making these free determinations, the Department asks that the locality from which the sample was obtained be given by the sender.

EXAMINATION FOR ASSAYERS.

The writer has the honour, as Secretary, to submit the Annual Report for the year 1936 of the Board of Examiners for Certificates of Competency and Licence to Practise Assaying in British Columbia, as established under the "Department of Mines Act, 1934."

A meeting of the Board of Examiners was held on May 16th, August 5th, and September 30th, 1936. Two candidates applied for examination on May 16th and both passed the examination. Seven candidates applied for examination on June 15th and all passed the examination. One candidate applied for exemption under section 10, subsection (2), of the Act on August 5th. The Board recommended that certificates be issued to the above-mentioned ten candidates.

In accordance with the recommendations of the Board, certificates have been duly issued by the Honourable the Minister of Mines to the ten successful candidates.

GOLD COMMISSIONERS AND MINING RECORDERS.

The following list shows the Gold Commissioners and Mining Recorders of the Province:—

Mining Division.	Location of Office.	Gold Commissioner.	Mining Recorder.	Deputy Recorder.
Atlin	Atlin	H. F. Glassey	H. F. Glassey	G. H. Hallett.
Sub-office	Telegraph Creek			T. S. Dalby.
Sub-office	Haines (U.S.)		(Com. for taking Affidavits)	B. A. Barnett.
Sub-office	Squaw Creek via Atlin			Mrs. F. Muncaster.
Sub-office	Tulsequah			H. L. Fraser.
Sub-office	Juneau (U.S.)		(Com. for taking Affidavits)	Harold E. Brown.
Stikine	Telegraph Creek	T. S. Dalby	T. S. Dalby	
Sub-office	Boundary via Telegraph Creek			Duncan Miller.
Sub-office	Burns Lake			T. E. Taylor.
Sub-office	McDame Creek			R. J. Meek.
Sub-office	Fort St. John			F. W. Beatton.
Sub-office	Dease Lake Townsite			John Fleming.
Skeena	Prince Rupert	N. A. Watt	N. A. Watt	A. J. Lancaster.
Sub-office	Kitimat			Chas. E. Moore.
Sub-office	Copper River			L. G. Skinner.
Sub-office	Terrace			O. T. Sundal.
Sub-office	Stewart (Portland Canal)			H. W. Dodd.
Sub-office	Rosswood			Mrs. Alberta Smith.
Sub-office	Kimsquit			Percy Gadsden.
Portland Canal	Stewart	N. A. Watt (at Prince Rupert)	H. W. Dodd	
Sub-office	Anyox			W. Eve.
Sub-office	Alice Arm			Mrs. L. Cummings.
Bella Coola	Prince Rupert	N. A. Watt	N. A. Watt	A. J. Lancaster.
Sub-office	Bella Coola			C. A. Brynildsen.
Sub-office	Bella Bella			
Sub-office	Ocean Falls			Geo. H. Hill.
Sub-office	Kimsquit			Percy Gadsden.
Queen Charlotte	Queen Charlotte	N. A. Watt	G. A. Charter, M.D.	
Sub-office	Jedway			W. T. Reavley.
Sub-office	Massett			J. C. Frizzell.
Sub-office	Lockeport			
Omineca	Smithers	H. B. Campbell	H. B. Campbell	
Sub-office	Fort Grahame			L. T. Kempple.
Sub-office	Bella Coola			C. A. Brynildsen.
Sub-office	Finlay Forks			A. MacKinnon.
Sub-office	Fort St. James			Mrs. A. Kynoch.
Sub-office	Manson Creek			W. B. Steele.
Sub-office	Telkwa			T. J. Thorp.
Sub-office	Prince George			Geo. Milburn.
Sub-office	Hudson Hope			F. F. Monteith.
Sub-office	Kimsquit			Percy Gadsden.
Sub-office	Fort St. John			F. W. Beatton.
Sub-office	Whitewater (Finlay River) via Fort Grahame			James Ware.
Sub-office	Cedarvale			John Thompson.
Sub-office	Terrace			O. T. Sundal.
Sub-office	Fort Fraser			J. D. Moore.
Sub-office	Vanderhoof			Geo. Ogsdon.
Sub-office	Pacific			T. H. McCubbin.
Sub-office	Hazelton			Wm. Grant.
Sub-office	Burns Lake			T. E. Taylor.
Sub-office	Usk			Jas. L. Bethurem.
Sub-office	Takla Landing			Mrs. Wilhemina Aiken.
Sub-office	Copper River			L. G. Skinner.

GOLD COMMISSIONERS AND MINING RECORDERS—*Continued.*

Mining Division.	Location of Office.	Gold Commissioner.	Mining Recorder.	Deputy Recorder.
Peace River	Fort St. John	H. B. Campbell (at Smithers)	F. W. Beatton	
Sub-office	Fort Nelson			J. S. Clark.
Sub-office	Prince George			G. Milburn.
Sub-office	Finlay Forks			A. MacKinnon.
Sub-office	Hudson Hope			F. F. Monteith.
Sub-office	Pouce Coupe			M. S. Morrell.
Cariboo	Barkerville	J. P. Scarlett	J. P. Scarlett	Miss L. D. Boyd.
Sub-office	Quesnel			E. C. Lunn.
Sub-office	Prince George			Geo. Milburn.
Sub-office	McBride			R. McKinlay.
Sub-office	Fort McLeod			J. E. McIntyre.
Quesnel	Williams Lake	L. C. Maclure	L. C. Maclure	
Sub-office	Quesnel			E. C. Lunn.
Sub-office	Likely			A. Morrison.
Sub-office	Barkerville			J. P. Scarlett.
Sub-office	Horsefly			A. B. Campbell.
Sub-office	Keithley Creek			Hugh Adams.
Sub-office	Hanceville			E. R. Hance.
Sub-office	Tatla Lake			Robt. Graham.
Clinton	Clinton	R. J. A. Dorrell	R. J. A. Dorrell	
Sub-office	Williams Lake			L. C. Maclure.
Sub-office	*Haylmore via Gold Bridge*			W. *Haylmore.*
Sub-office	Tatla Lake			Robt. Graham.
Sub-office	Hanceville			Edwin Rennie Hance.
Kamloops	Kamloops	E. Fisher	E. Fisher	D. G. Dalgleish.
Sub-office	Chu Chua			George M. Fennell.
Sub-office	Vavenby			H. Finley.
Sub-office	Salmon Arm			A. P. Suckling.
Ashcroft	Ashcroft	E. Fisher (at Kam.)	W. F. Knowlton	
Sub-office	Lytton			H. Elgie.
Nicola	Merritt	E. Fisher (at Kam.)	A. G. Freeze	
Yale	Hope	E. Fisher (at Kam.)	H. Beech	
Sub-office	Lytton			H. Elgie.
Similkameen	Princeton	Chas. Nichols	Chas. Nichols	
Sub-office	Hedley			
Vernon	Vernon	R. M. McGusty	R. M. McGusty	F. H. C. Wilson.
Sub-office	Kelowna			C. W. Dickson.
Greenwood	Greenwood	L. A. Dodd	L. A. Dodd	
Sub-office	Kettle Valley			G. B. Gane.
Sub-office	Beaverdell			T. W. Clarke.
Sub-office	Oliver			W. H. Laird.
Grand Forks	Grand Forks	E. Harrison	E. Harrison	
Osoyoos	Penticton	W. R. Dewdney	W. R. Dewdney	
Sub-office	Keremeos			L. S. Coleman.
Sub-office	Hedley			R. E. Baxter.
Sub-office	Oliver			W. H. Laird.
Golden	Golden	A. W. Anderson	A. W. Anderson	C. J. Dainard.
Windermere	Windermere	A. W. Anderson (at Golden)	A. M. Chisholm	
Fort Steele	Cranbrook	J. E. Kennedy	J. E. Kennedy	A. A. Robertson.
Sub-office	*Fernie*			J. R. Nolan.
Ainsworth	Kaslo	Ronald Hewat	W. M. H. Dunn	
Sub-office	Trout Lake			R. McPherson.
Sub-office	Poplar Creek			A. Robb.
Slocan	New Denver	Ronald Hewat (at Kaslo)	Frank Broughton	
Sub-office	Sandon			W. J. Parham.
Slocan City	Slocan	Ronald Hewat	T. McNeish	W. E. Graham.
Nelson	Nelson	J. Cartmel	J. Cartmel	J. A. Stewart.
Sub-office	Creston			R. H. Hassard.
Sub-office	Ymir			Wm. Clark.
Sub-office	Salmo			M. C. Donaldson.
Arrow Lake	Nakusp	J. Cartmel (at Nelson)	N. A. Herridge	
Revelstoke	Revelstoke	Wynfield Maxwell	W. Maxwell	W. G. Fleming.

GOLD COMMISSIONERS AND MINING RECORDERS—*Continued.*

Mining Division.	Location of Office.	Gold Commissioner.	Mining Recorder.	Deputy Recorder.
Lardeau	Beaton	Wynfield Maxwell (at Revelstoke)	Stephen Rowe	
Sub-office	Trout Lake			R. McPherson.
Trail Creek	Rossland	W. H. Reid	W. H. Reid	
Nanaimo	Nanaimo	C. L. Monroe	C. L. Monroe	W. H. Cochrane.
Sub-office	Ladysmith			J. A. Knight.
Sub-office	Alert Bay			Jos. Howe.
Sub-office	Vananda			Henry Carter.
Sub-office	Shoal Bay, Thurlow P.O.			C. C. Thompson.
Sub-office	Granite Bay			H. J. Bull.
Sub-office	Cumberland			S. B. Hamilton.
Sub-office	Alberni			W. H. Boothroyd.
Alberni	Alberni	W. H. Boothroyd	W. H. Boothroyd	G. C. Rolf.
Clayoquot	Clayoquot	W. H. Boothroyd (at Alberni)	W. T. Dawley	
Sub-office	Nanaimo			C. L. Monroe.
Sub-office	Ceepeecee			P. McGregor.
Quatsino	Quatsino	W. H. Boothroyd (at Alberni)	Ed. Evenson	
Victoria	Victoria	R. J. Steenson	P. J. Mulcahy	
New Westminster	New Westminster	A. P. Grant	A. B. Gray	
Sub-office	Chilliwack			Chas. J. Whittaker.
Vancouver	Vancouver	A. S. Tyrer	R. A. Burgoyne	
Sub-office	Alert Bay			Jos. Howe.
Sub-office	Powell River			A. C. Sutton.
Sub-office	Shoal Bay, Thurlow P.O.			C. C. Thompson.
Lillooet	Lillooet	L. J. Price	L. J. Price	T. B. Williams.
Sub-office	Haylmore via Gold Bridge			W. Haylmore.

GOLD COMMISSIONERS' AND MINING RECORDERS' OFFICE STATISTICS, 1936.

District and Division.	Free Miners' Certificates.			Lode-mining.					Placer-mining.				Revenue.		Total.	
	Individual.	Company.	Special.	Mineral Claims recorded.	Certificates of Work.	Bills of Sale, etc.	Certificates of Improvements.	Leases of Re-verted Crown-granted Mineral Claims.	Placer Claims recorded.	Placer Leases recorded (Bench, Creek, and Dredging).	Certificates of Work, Placer Leases.	Bills of Sale, etc.	Free Miners' Certificates.	General.	Mining Divisions.	Districts.
North-western District (No. 1)																**$22,201.80**
Atlin	336	6	2	56	51	9	28	3	66	43	159	51	$2,006.50	$9,250.80	$11,257.30	
Stikine	86				21	2					8	1	413.00	769.00	1,182.00	
Liard	56			108	106	17				14	32	18	263.50	3,207.40	3,470.90	
Nass River	57	2		65	127	7	2						416.50	522.00	938.50	
Portland Canal	179	5		249	540	37	9				1	1	1,245.00	2,299.60	3,544.60	
Skeena	117	1		79	71	19	3	6		5		1	653.25	706.95	1,360.20	
Queen Charlotte	26			18	10	5			2		2	5	97.00	189.75	286.75	
Bella Coola	28			1	6	9				1			101.00	60.55	161.55	
North-eastern District (No. 2)																**66,877.22**
Cariboo	397	14	6	915	1,053	207	46		44	254	635	274	3,068.00	34,619.05	37,687.05	
Quesnel	413	4	4	301	306	45			48	91	193	82	2,043.50	12,381.45	14,424.95	
Omineca	501	12	2	247	805	97	1	3	30	52	232	77	3,285.75	11,361.22	14,646.97	
Peace River	26								1	1	2	1	113.25	5.00	118.25	
Central District (No. 3)																**13,135.20**
Nicola	69			149	83	23							282.25	677.35	959.60	
Vernon	290	2	1	143	173	53		1	31	42	23	43	1,342.50	3,489.15	4,831.65	
Kamloops	541	3	2	290	327	99	2	5	32	40	23	54	2,768.75	4,575.20	7,343.95	
Southern District (No. 4)																**19,627.25**
Grand Forks	76		3	71	80	10		13			3		384.25	949.00	1,333.25	
Greenwood	160	5		159	349	20	1	20	9	16	25	23	1,114.00	3,640.45	4,754.45	
Osoyoos	252	8		235	394	41	26	13					1,697.00	2,249.20	3,946.20	
Similkameen	295	5		175	330	19	7		15	42	72	46	1,568.00	8,025.35	9,593.35	
Eastern District (No. 5)																**33,117.63**
Fort Steele	426	2	1	224	267	35		2	28	29	64	44	1,978.75	5,767.25	7,746.00	
Windermere	55	2	1	66	77	11			3	1		4	350.75	570.35	921.10	
Golden	70	3		36	50	3				1	3	7	376.25	2,224.33	2,600.58	
Ainsworth	147	4		83	181	40	1	36	3	4			980.50	1,934.65	2,915.15	
Slocan	44	2		43	67	3	1						409.25	381.75	791.00	
Slocan City	58			75	85	5							261.50	715.75	977.25	
Nelson	506	14	3	458	787	134	6	61	63	5	6	19	3,675.75	6,689.10	10,364.85	
Arrow Lake	22			15	11	6				5			99.25	85.25	184.50	
Trail Creek	170	9		29	21	9		18		11	11		1,369.00	955.00	2,324.00	
Revelstoke	89		1	12	90	7		9	7	35	11	36	425.50	3,056.35	3,481.85	
Lardeau	43	1		70	130	13							274.00	537.35	811.35	
Western District (No. 6)																**69,665.85**
Nanaimo	124	1	3	292	236	38	7	8					467.00	1,798.20	2,265.20	
Alberni	89	3	1	70	56	13	9	3		7			584.00	512.35	1,096.35	
Clayoquot	75			195	190	37			5	7			338.00	2,552.00	2,890.00	
Quatsino	29			7	19								131.50	65.25	196.75	
Victoria	225	15	4	43	20	7		18	7	6	7	2	2,490.75	1,623.00	4,113.75	
Lillooet	588	44	1	1,796	2,007	359	160		5	4	46	6	6,307.50	15,301.90	21,609.40	
Clinton	63			127	191	25	10		36	16	16	41	352.75	2,445.75	2,798.50	
Ashcroft	130	3	1	177	326	61			8	18	9	5	983.50	2,703.00	3,686.50	
Yale	176	8	2						15	6	14	2	1,478.50	4,434.90	5,913.40	
New Westminster	201	5	3	291	207	42		5	8	13	8	3	1,191.25	1,947.60	3,138.85	
Vancouver	1,878	161	29	137	277	47		1					20,678.00	1,279.15	21,957.15	
Totals	9,113	344	70	7,507	10,127	1,614	319	225	466	769	1,605	846	$68,066.25	$156,558.70	$224,624.95	**$224,624.95**

VICTORIA, B.C.:
Printed by CHARLES F. BANFIELD, Printer to the King's Most Excellent Majesty.
1937.

4,725-237-4740

The Annual Report of the Minister of Mines is now issued in parts as follows:—

Part A.—The Mining Industry (Statistical Review). John F. Walker.

Part B.—North-western Mineral Survey District (No. 1). Joseph T. Mandy.

Part C.—North-eastern Mineral Survey District (No. 2). Douglas Lay.

Part D.—Southern and Central Mineral Survey Districts (Nos. 3 and 4). M. S. Hedley.

Part E.—Eastern Mineral Survey District (No. 5). H. Sargent.

Part F.—Western Mineral Survey District (No. 6). B. T. O'Grady.

Part G.—Inspection of Mines. James Dickson.

PART B

ANNUAL REPORT

OF THE

MINISTER OF MINES

OF THE PROVINCE OF

BRITISH COLUMBIA

FOR THE

YEAR ENDED 31ST DECEMBER

1936

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:
Printed by CHARLES F. BANFIELD, Printer to the King's Most Excellent Majesty.
1937.

BRITISH COLUMBIA DEPARTMENT OF MINES.

VICTORIA, B.C.

Hon. GEORGE S. PEARSON, *Minister.*

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

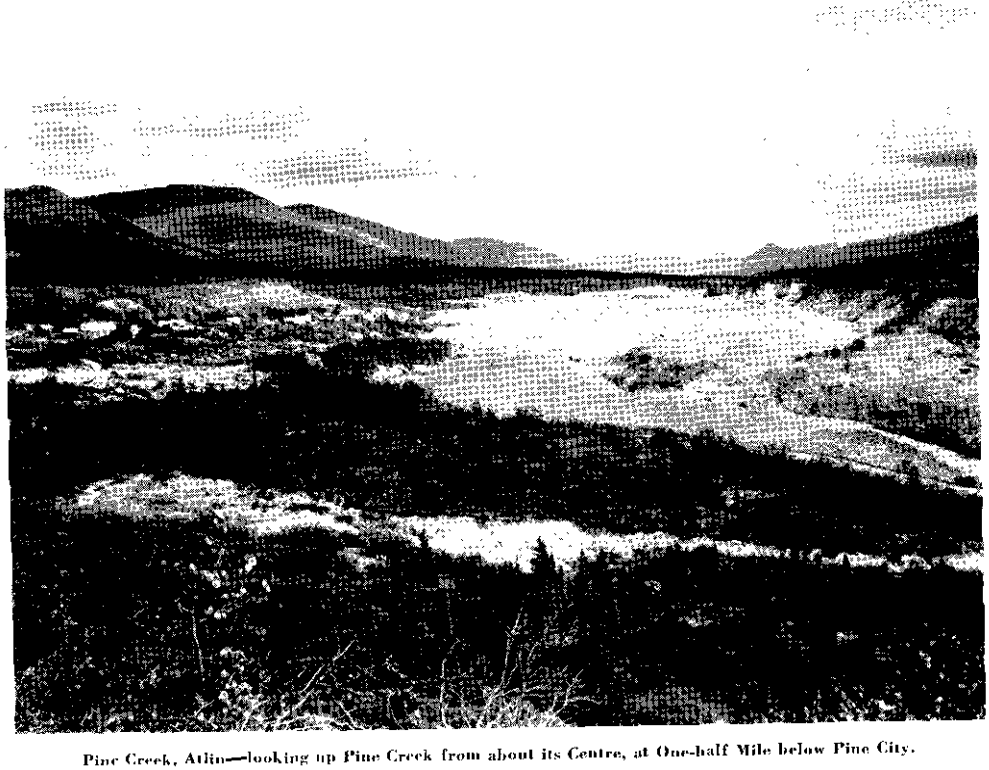
JAMES DICKSON, *Chief Inspector of Mines.*

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

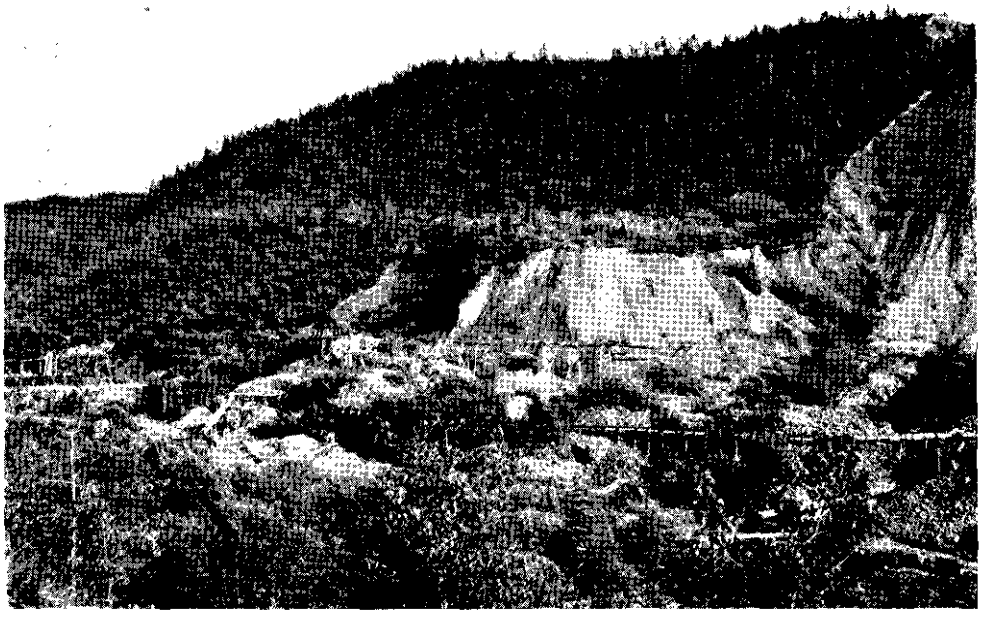
P. B. FREELAND, *Chief Mining Engineer.*

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

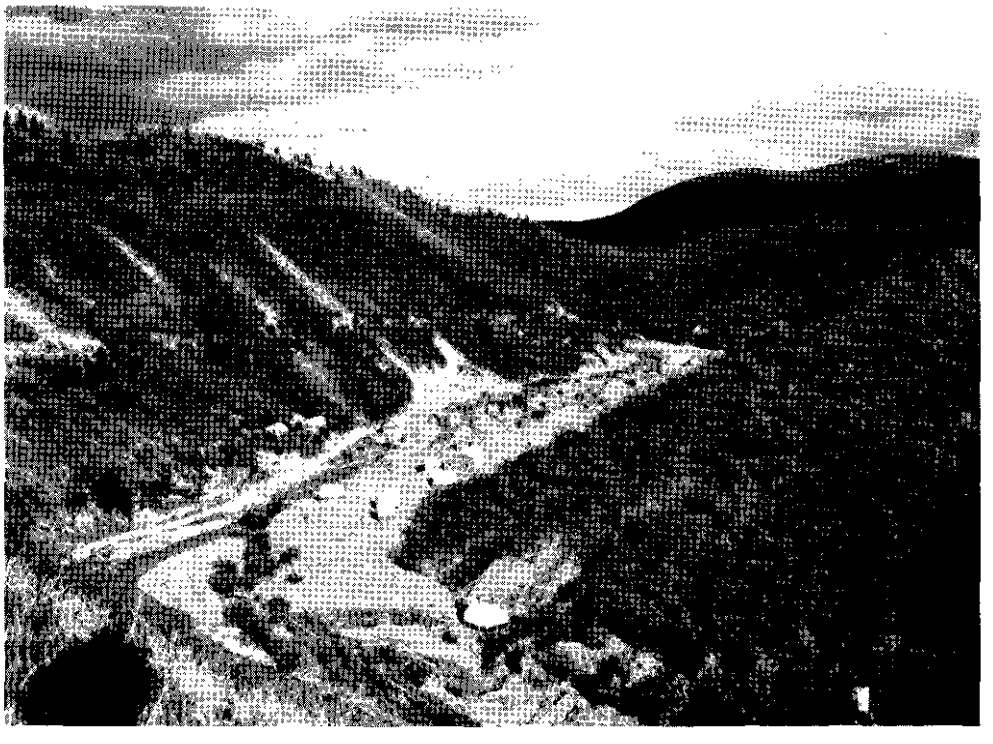
Cascade Creek Area, Stewart—looking North to Long Lake and Outre Mountain.



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.

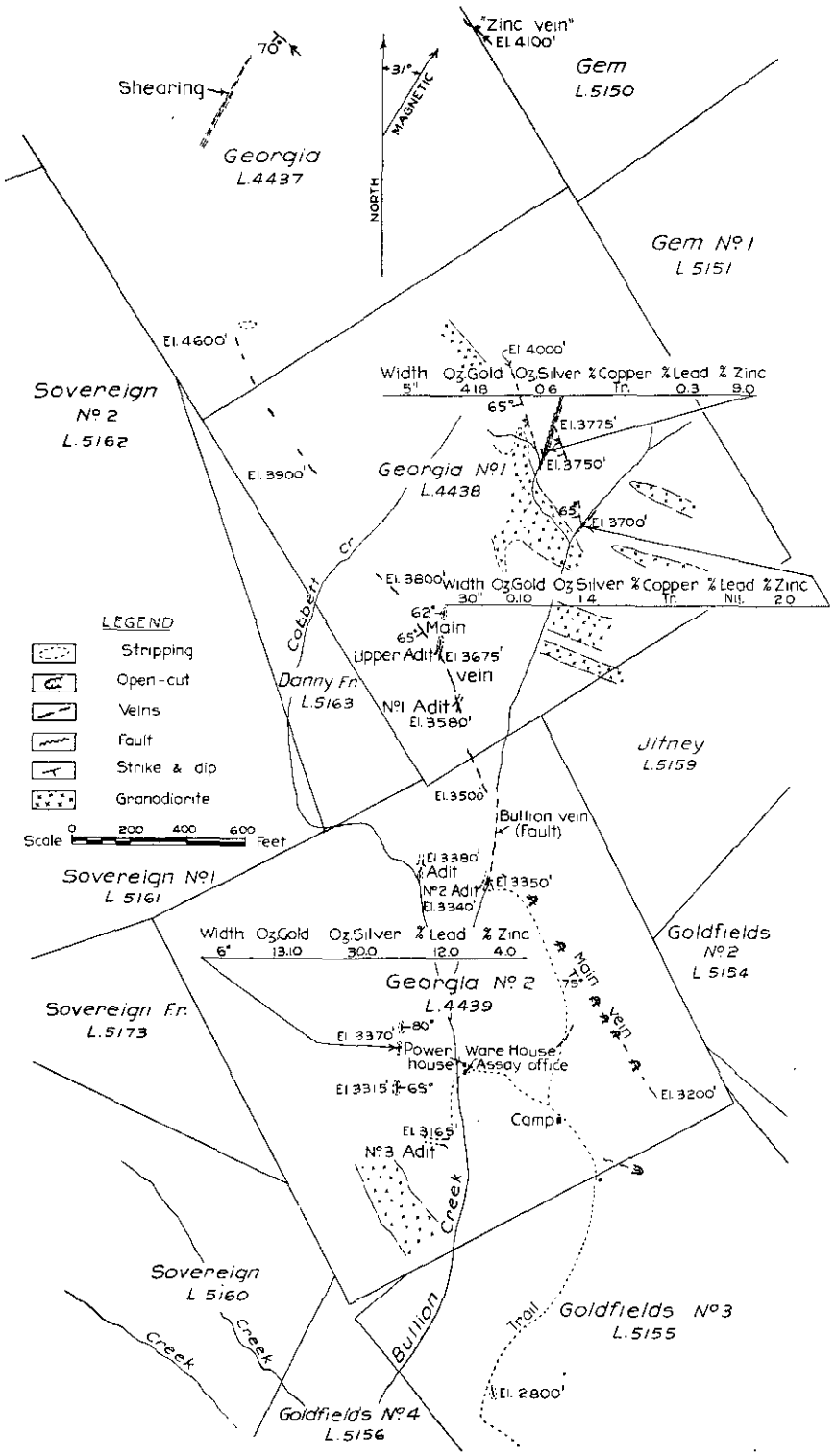
The rocks underlying the area consist chiefly of altered crystalline andesitic flows (greenstone) and altered, probably tuffaceous, sediments. These rocks have been subjected locally to strong shearing movements and are altered to mica-schists, especially in the vicinity of major, north-striking fault-zones. 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.

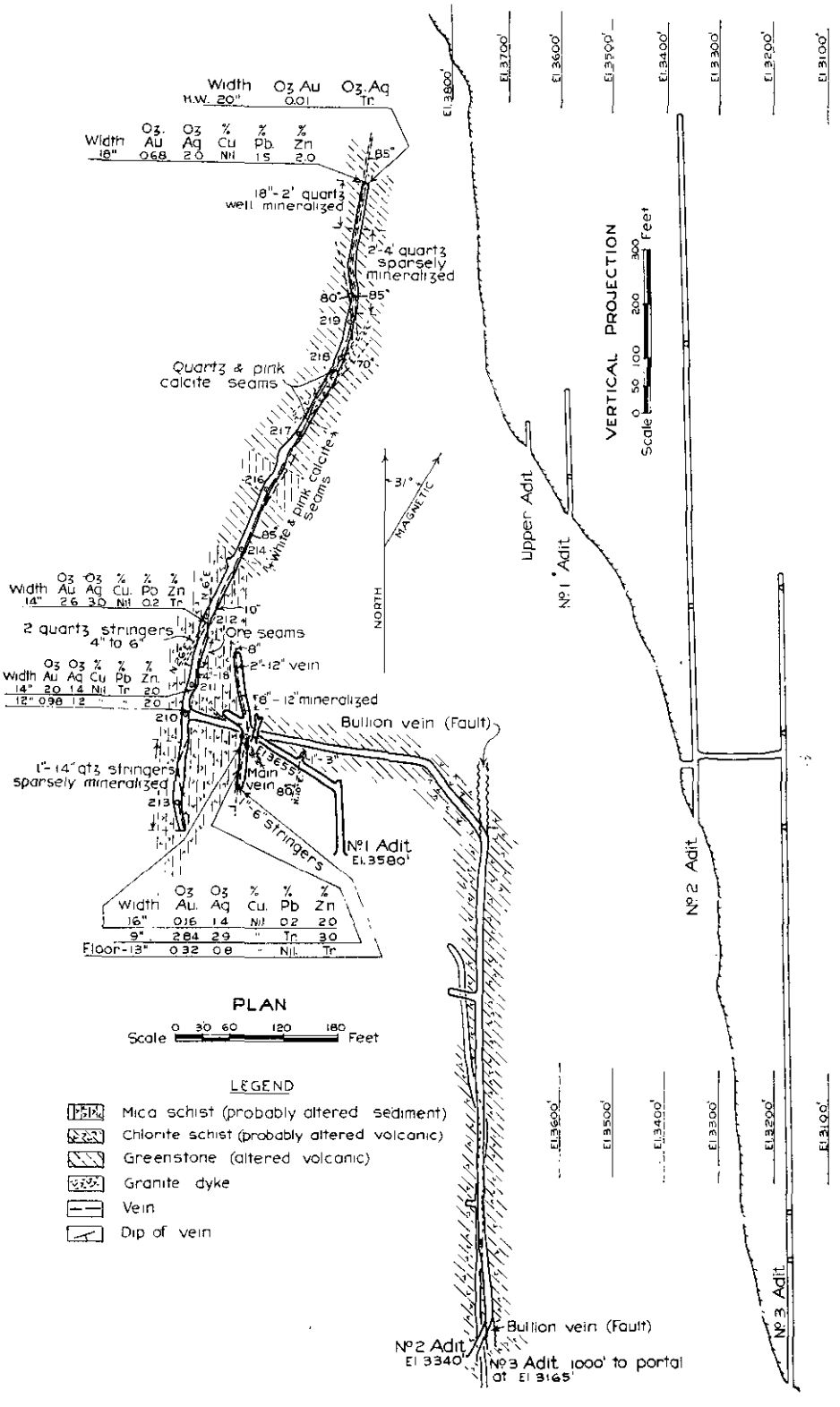
About 240 feet north-westerly from the portal of No. 3 adit, and at about 150 feet higher elevation, a series of open-cuts ("High-grade" cuts) along a distance of 200 feet between elevation 3,315 and 3,370 feet exposes a quartz vein ("South-west" vein) from 6 to 18 inches wide, striking north and dipping 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-porphyry 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.

Premier Extension Gold Mining Co., Ltd.

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.

Indian Mines Corporation, Ltd. 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, 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 1½ 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 bunchy 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 2½ 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 footwall 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 sufficint 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.

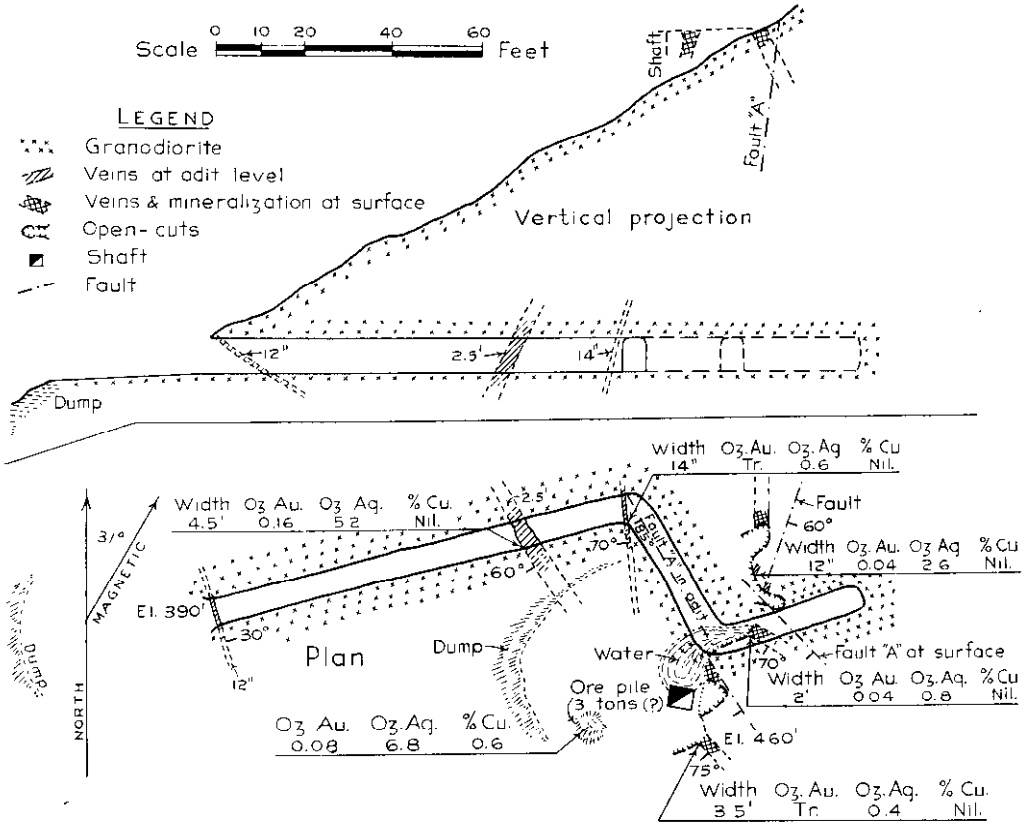
Bear River Area, Portland Canal.

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 phanerocrystalline 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 footwall 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 ¼ 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 ¾ to 1½ miles wide. At the junction of the stream with the Taku, on the west side, a flat slough and beaver-dam area 2½ 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.)

Polaris-Taku Mining Co., Ltd.

This company was incorporated in British Columbia on October 17th, 1936, as a private limited company. On November 4th, 1936, it acquired the interest 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 ¾ to 1½ 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:—

ARSENICAL-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: HNO_3—quickly tarnishes iridescent.
HCl, KCN, $FeCl_3$, KOH, $HgCl_2$—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:—

	Per Cent.
Arsenopyrite	65.1
Pyrite	34.9
	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.

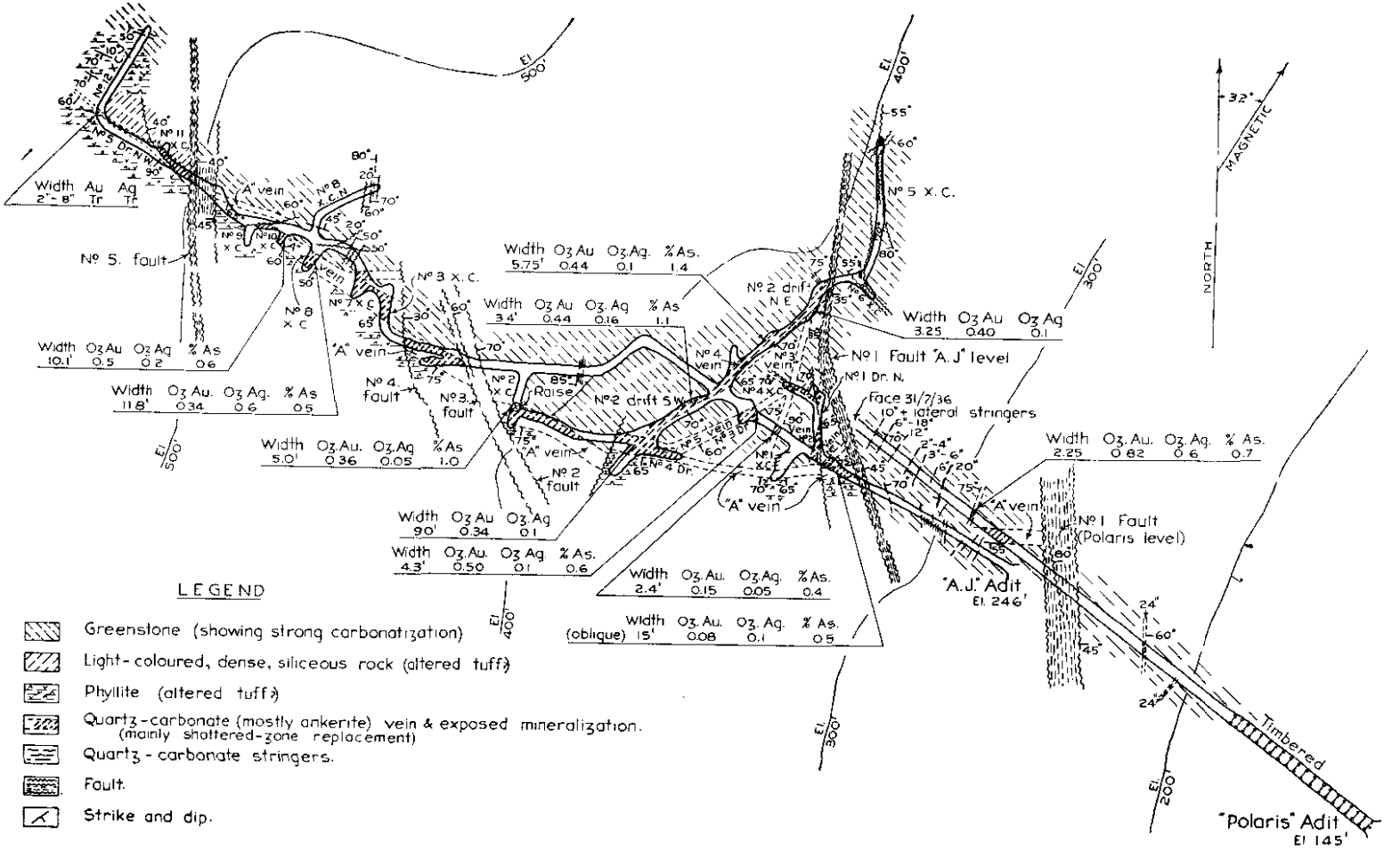
At about elevation 200 feet and 1,000 feet north-easterly from the "A.J." adit, a well-defined replacement-zone in greenstone (" Blue Bird ") is exposed by open-cuts on both sides of Whitewater Creek. It strikes north 7 degrees west and is well mineralized with finely-disseminated arsenopyrite and pyrite 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 sulphide 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 " side-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 Group, 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.

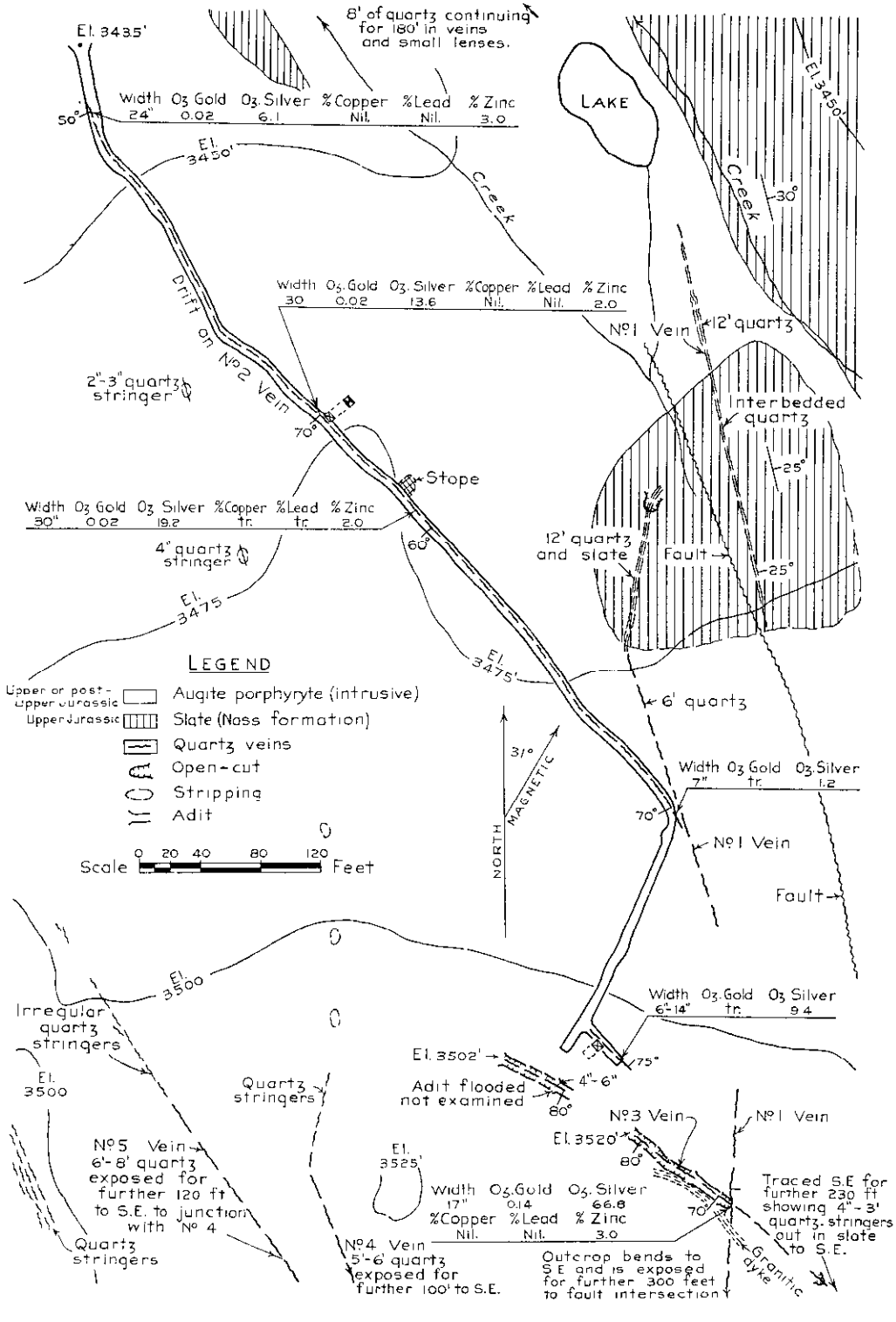
SILVER-LEAD-ZINC DEPOSITS.

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	*Nil*	*Nil*	3.0
296 feet south-east of portal	30	0.02	13.6	*Nil*	*Nil*	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 1⅝ 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 chalcopyrite, 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 chalcopyrite. 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.

Ketchum and Stop-and-Rest. 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.

Dolly Varden. 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.

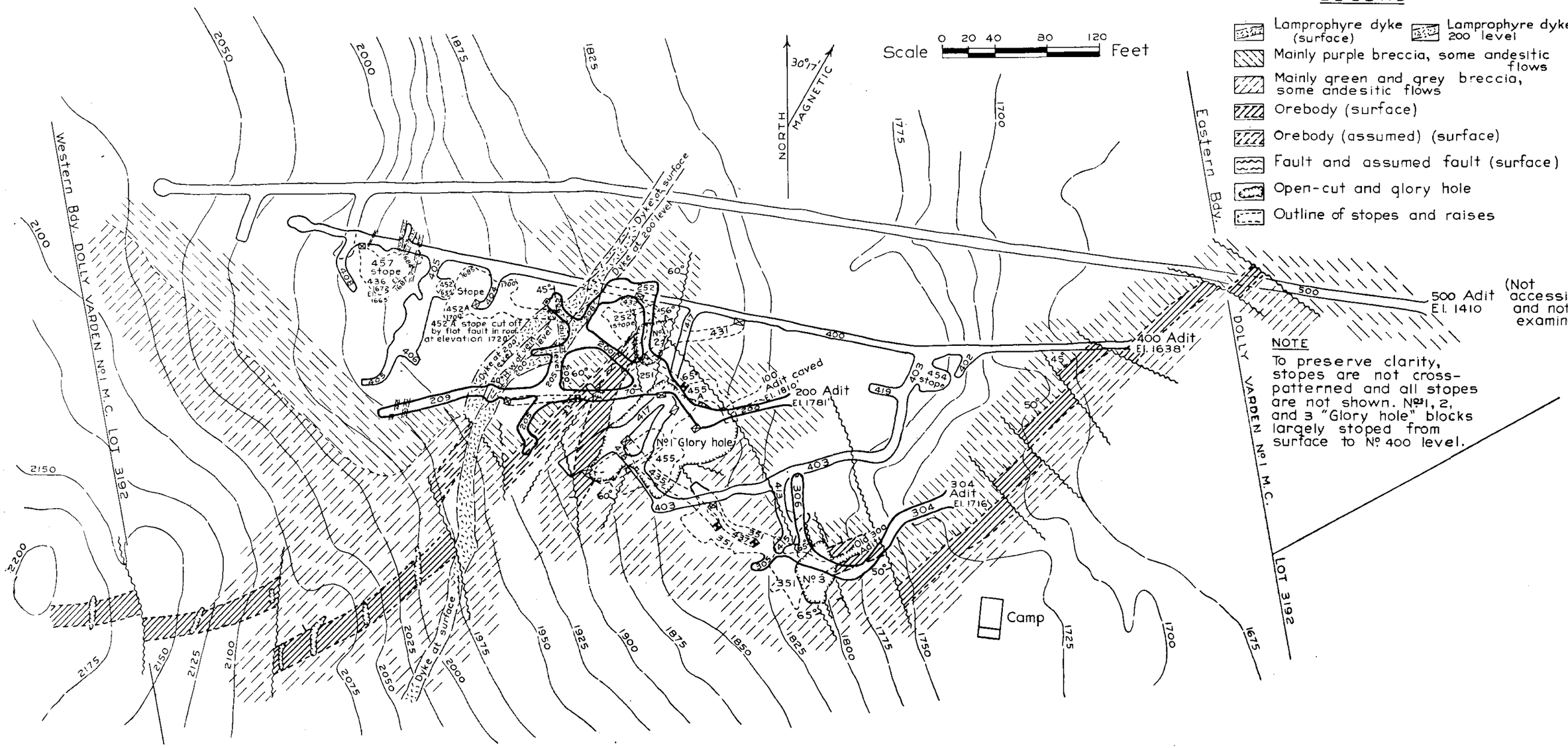
The *Dolly Varden* group was staked in 1910 by Ole Evindsen and partners, of Alice Arm, and was the first location in the Upper Kitsault Valley. In 1915 the Dolly Varden Mines Company was organized by Chicago, Boston, and New York interests, and after preliminary exploration underground and limited diamond-drilling 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.	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



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 2½ 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 chalcopyrite 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.

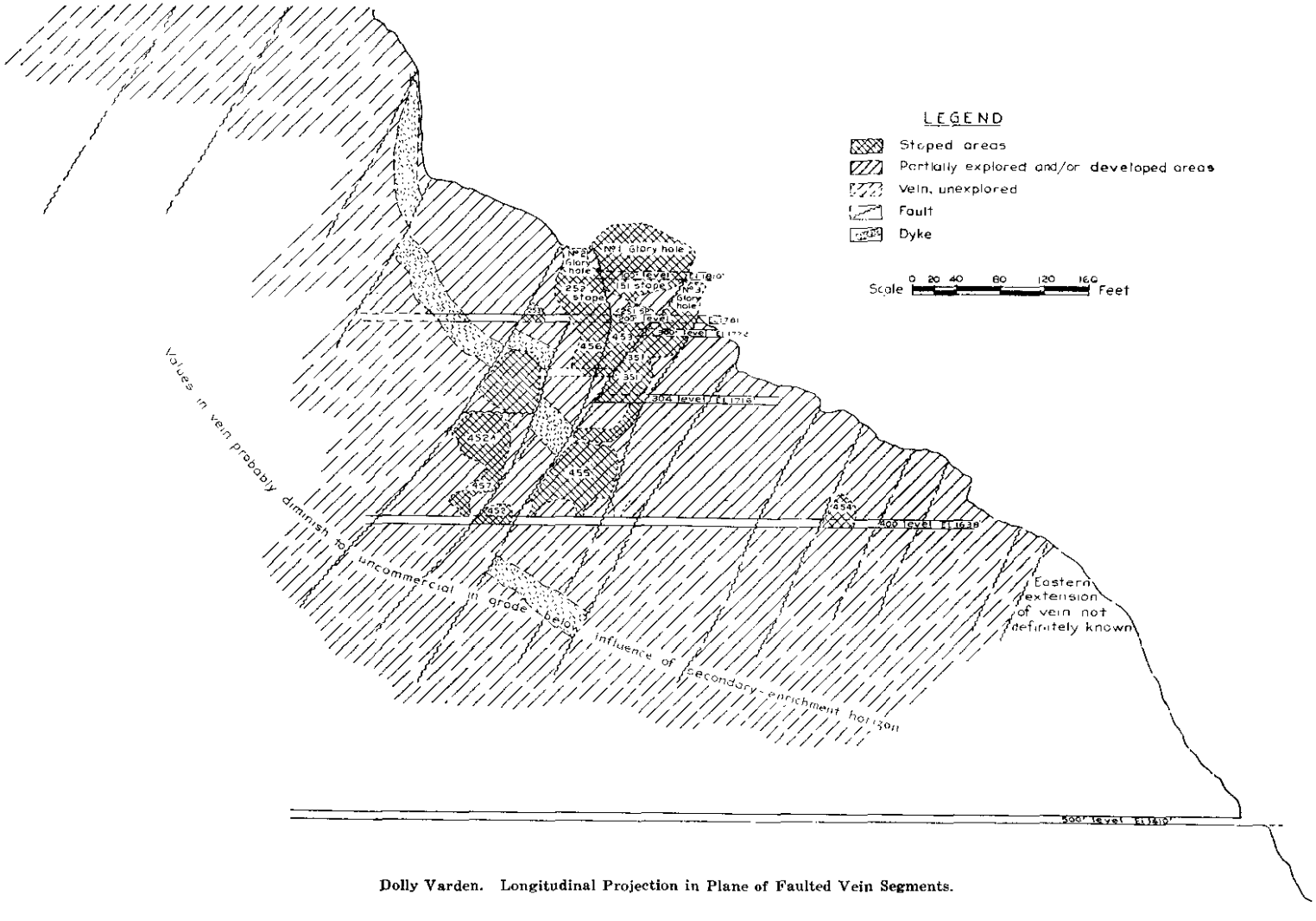
The easterly 650 feet of the zone outcrops along and adjacent to the contact of the purple fragmental rocks with the green, massive, and partly fragmental volcanics. At the westerly extremity of this length the contact swings sharply north-west and the westerly 400 feet of the zone outcrops in the green, 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, 1638, 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.

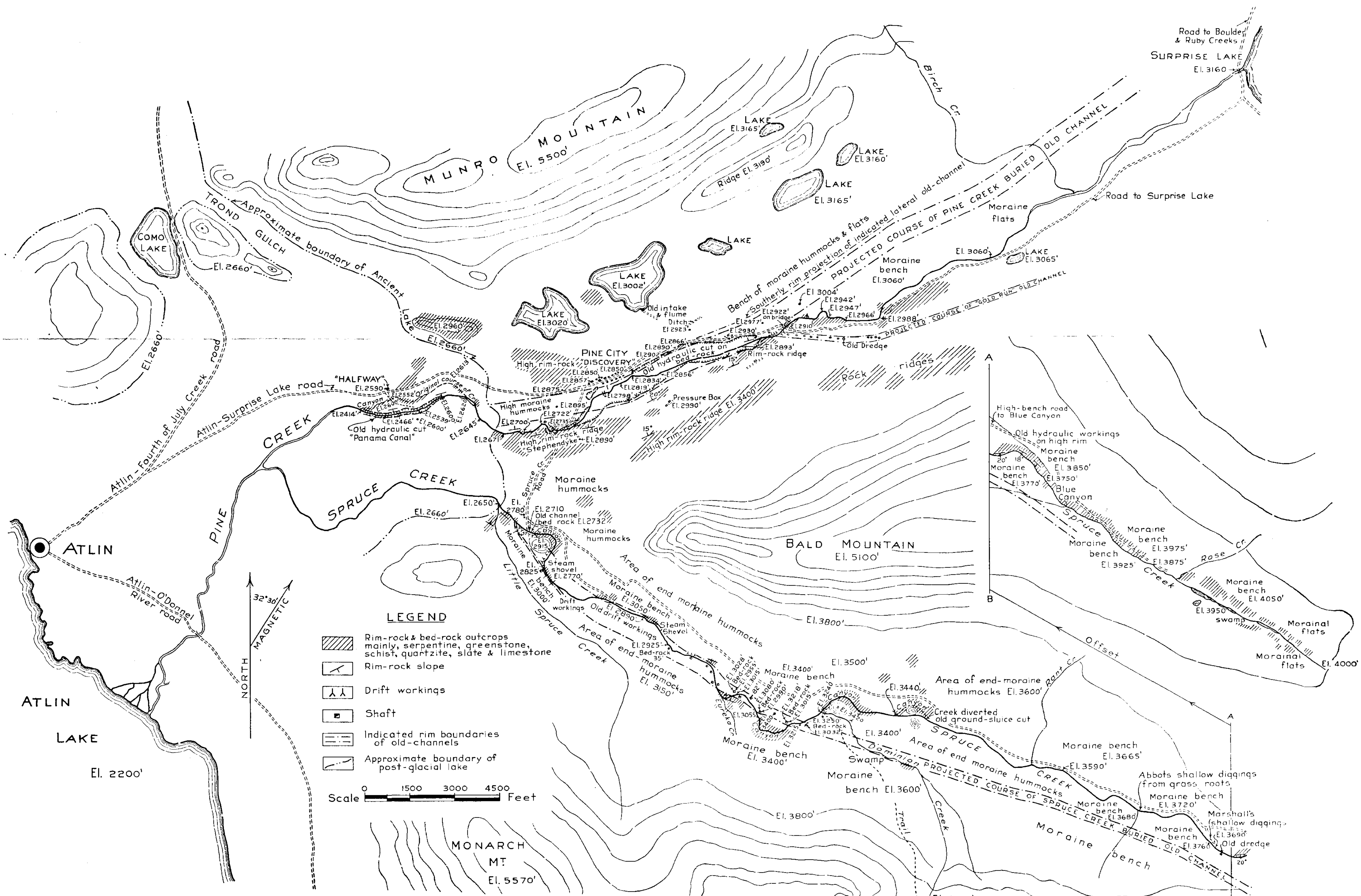
Since the discovery of the Atlin Camp there has been an appreciable but fluctuating placer-gold output. Although figures of production from each individual creek are not available, a study of records indicates that a large proportion of the total production has come from Pine and Spruce Creeks. The most 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	8,384	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.



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 northwesterly 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 13½ 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 2¼ 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 1¾ 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 3½ miles from its mouth, the rocky section of "Stevendyke," about 1½ miles above "Halfway," and a rocky area three-quarters of a mile long about 3½ 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 4¾ miles of its course the creek-gradient

is about 2 per cent.; in the central 4¾ miles it is about 1.5 per cent.; and in the upper 2½ 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 4½ 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-sluicing 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-stoping 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 7½ 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 pot-holed 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 2,682½ 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 82½ 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-imbricated 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 ½ 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 7½-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 *Croker* 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 Lykkergaard, 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.

Poker Lease. 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 (½ 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).

Joker and Croker Leases. These bench leases adjoin the *Poker* on the south-east and are owned by 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."

Bratt, Morse & Co. This partnership is drifting in the old channel under Spruce Creek on the *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.

Wolf Lease. This bench lease, adjoining the Bratt-Morse ground on the south, covers the 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.

Clydesdale Lease. This bench lease adjoins the Morse creek-ground and the *Chance* creek claim 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 crosscutting. 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-sluices are maintained, and for the direction of the workings values are ascertained by sluicing a known number of cars from definite sections.

Dream Lease. This bench lease adjoins the *Sunlight*, a southerly fraction of the *Canyon* 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 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.

INDEX.

ILLUSTRATIONS.

VICTORIA, B.C.:
Printed by CHARLES F. BANFIELD, Printer to the King's Most Excellent Majesty.
1937.

4,725-237-4740

The Annual Report of the Minister of Mines is now issued in parts as follows:—

Part A.—THE MINING INDUSTRY (STATISTICAL REVIEW). John F. Walker.

Part B.—NORTH-WESTERN MINERAL SURVEY DISTRICT (No. 1). Joseph T. Mandy.

Part C.—NORTH-EASTERN MINERAL SURVEY DISTRICT (No. 2). Douglas Lay.

Part D.—SOUTHERN AND CENTRAL MINERAL SURVEY DISTRICTS (NOS. 3 AND 4). M. S. Hedley.

Part E. EASTERN MINERAL SURVEY DISTRICT (No. 5). H. Sargent.

Part F.—WESTERN MINERAL SURVEY DISTRICT (No. 6). B. T. O'Grady.

Part G.—INSPECTION OF MINES. James Dickson.

PART C

ANNUAL REPORT

OF THE

MINISTER OF MINES

OF THE PROVINCE OF

BRITISH COLUMBIA

FOR THE

YEAR ENDED 31ST DECEMBER

1936

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:
Printed by CHARLES F. BANFIELD, Printer to the King's Most Excellent Majesty.
1937.

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.*

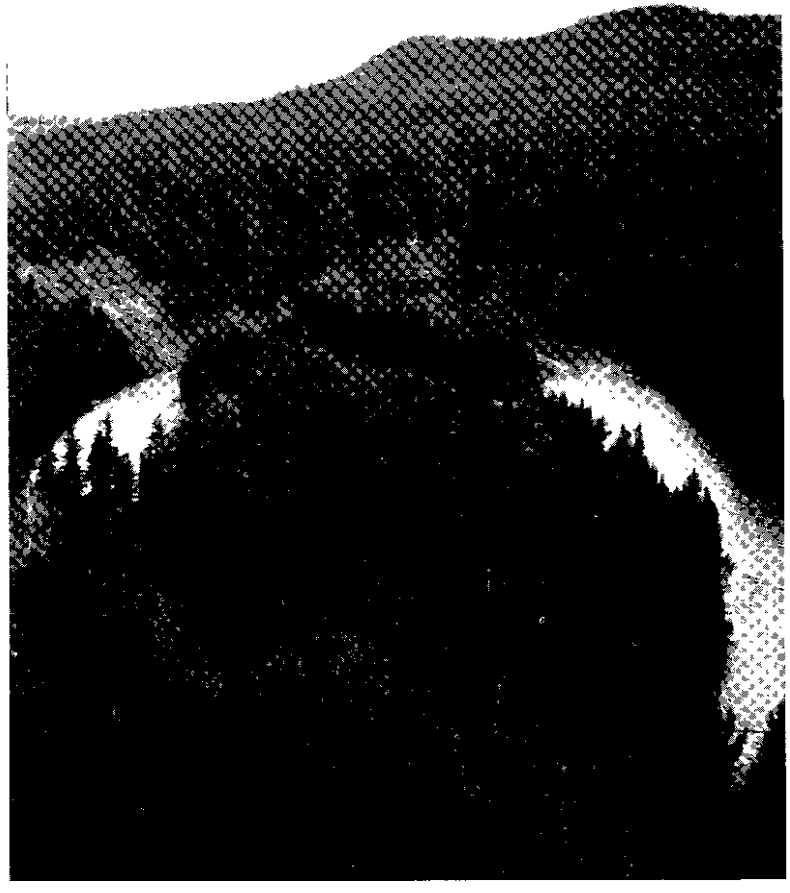
P. B. FREELAND, *Chief Mining Engineer.*

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

Germansen Mines, Ltd., 1935–36. Pit showing Section of Gravels.

Bullion Placers—looking at Face of Bullion Pit. Clean-up in Progress, October 1st, 1936.

Germansen River below Horseshoe Creek, in Steep Rock-walled Valley.



Hairpin Bend of Cottonwood River. Lease of F. Kruczek.

PART C.

NORTH-EASTERN MINERAL SURVEY DISTRICT (No. 2).

BY

DOUGLAS LAY.

SUMMARY.

Activity during the year again centred largely on lode- and placer-gold deposits.

Lode-gold production suffered from the interruption to operations at the property of Cariboo Gold Quartz Mining Company, Limited, caused by the loss by fire of the power plant in March. On completion of its new power plant this company increased its rate of milling to 200 tons daily, and the combined daily tonnage milled by this company and Island Mountain Mines Company, Limited, the two producing lode-gold properties in the Cariboo District, now reaches about 325 tons.

An increase in lode-gold mining activity was general throughout the Cariboo District.

Mining activities were confined to individual and small-scale effort in the Omineca Mining Division. The lode-gold possibilities of certain parts of this Mining Division, to which attention has been drawn in the publications of this Department, seem to warrant more active investigation than is now taking place.

Great activity continued in placer-mining, and it is now estimated that the production will be greater than for many years past. The chief contributors were Consolidated Gold Alluvials of B.C., Limited, and Bullion Placers, Limited.

The growth of activity in the Manson section during the year was marked, and quite heavy motor-truck traffic developed in the autumn on the route to this section from Fort St. James. Examination during the year rendered evident that this section is responding well to development, and present activities seem likely to be maintained.

Noteworthy was the adaptation of the Diesel-powered "bulldozer" to placer-mining operations by the Consolidated Mining and Smelting Company, Limited, at its property on Slate Creek. The many purposes to which this useful machine can be put seem likely to meet with increasing recognition in placer operations of a certain kind.

A pilot-mill of 2 tons hourly capacity for the recovery of tungsten was erected at the *Hardscrabble* mine near Wells by Columbia Tungstens, Limited. The management anticipated that it would be possible to commence milling in the late autumn.

Much activity was manifested by prospectors generally. The initiative and energy shown by individual placer-miners and the success they obtained was noteworthy. New discoveries were made of occurrences of lode gold, placer, manganese, and magnetite, of which further mention will be found in the body of this report.

Coal-mining was carried on by F. M. Dockrill at the Bulkley Valley Colliery, and by the Northwest Anthracite Syndicate on Hudson Bay Mountain.

The writer desires to express his cordial thanks for the co-operation and kind hospitality extended by prospectors and mine operators in the course of his duties.

Production from this district for the year is as follows: Ore, 95,419 tons; gold, lode, 36,772 oz.; silver, 7,862 oz.; lead, 763 lb.; zinc, 954 lb.; placer gold, 21,298 oz.

PLACER DEPOSITS.

GERMANSEN RIVER.

Introduction.

A period of ten days was occupied in an examination of placer deposits on this river. Those now being worked are confined to the lower half of the river, but as a correct understanding of these cannot be obtained without consideration of the river as a whole, and surrounding topographic and other features, a short time was spent in an examination of the upper part of the river.

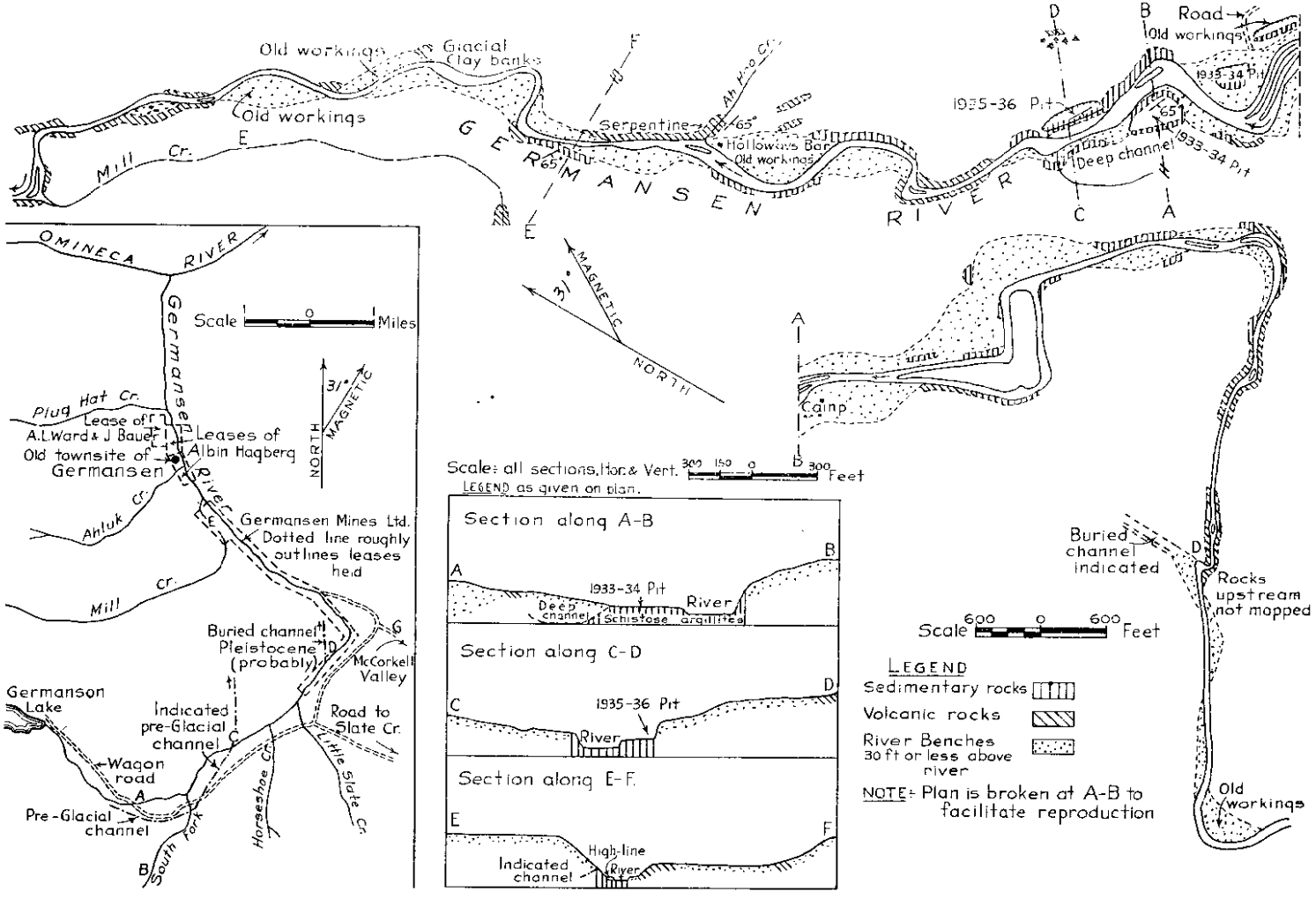
Germansen Lake may be reached by aeroplane from Fort St. James within one hour. Alternatively, the river or lake may be reached by the road now in the course of construction between Fort St. James and the Manson section. In this section there is now quite an extensive wagon-road system connecting Lost Creek, Slate Creek, Germansen River, and Germansen Lake. The road from Fort St. James was not, in the autumn, passable throughout for motor traffic. The distance from Fort St. James to Slate Creek (camp of Consolidated Mining and Smelting Company, Limited) is about 120 miles. Distances from this point to Germansen Lake, and to the camp of Germansen Mines, Limited, on Germansen River, are 9 miles and 8 miles respectively. From the property of Germansen Mines, Limited, the road follows the high ground on the right bank of the river descending to river-level at Ah Hoo Creek. From this point a foot-trail follows the river closely to a foot-bridge just above the old townsite of Germansen, and thereafter follows the west side of the river to its mouth. The grade followed as far as Ah Hoo Creek is easy, and this part of the road could with little difficulty be made passable for motor traffic.

The Germansen River rises in Germansen Lake and flows south-easterly for the first 2 miles in a wide valley of mature relief. It then turns sharply north-east to enter a rock canyon about three-quarters of a mile long, with walls rising some hundreds of feet above the river. The South Fork, hardly less inferior in size, joins the main stream below the canyon after flowing on the opposite side of the wide rock-walled valley for a distance of about half a mile. Continuing for 4½ miles, the river makes another sharp turn to flow north-westerly to its confluence with the Omineca River. The upper part of the north-westerly-trending stretch of the valley is wide and the relief mature, save that numerous gravel-covered rock benches occur in this part. In the vicinity of Mill Creek the valley narrows and the river below this point is confined in a canyon about 2½ miles in length, from which it emerges to enter the wide valley of the Omineca River. For the most part, the river-valley is incised to a depth of about 250 feet, and the region adjacent to the river is in main well timbered save in certain parts. The following topographic features are deemed likely to have an important bearing on placer occurrence: (A.) The deep rock canyon, 2 miles below Germansen Lake. (B.) The wide valley of mature relief, in which the South Fork is contained. The direction of this valley coincides so closely with the north-eastward-trending part of the Germansen River Valley that the narrow cleft forming the canyon by which the Germansen River enters it is relatively inconspicuous. (C.) About 1 mile down-stream from the mouth of the South Fork there is a gap in the rock walls of the valley and an extensive high bank of gravels occurs on the left bank of the river. Immediately above an extensive upland plateau-like area, dotted with many small lakes and muskegs, trends northward, west of the river. On the south side of the river at this point sliding glacial banks cause much trouble to the ditch-line of Germansen Mines, Limited. (D.) The local sharp bend of the river about 3,000 feet above the down-stream end of the north-easterly-flowing part. (E.) The wide and shallow depression trending parallel to the river occupied by the lower part of Mill Creek is approximately as indicated on the accompanying map. (F.) Slate Creek Valley. (G.) McCorkell Valley, or "Little Wolverine" Pass, as it was formerly named. (H.) The long canyon below Mill Creek. These features are designated by letter to facilitate reference and are further discussed in subsequent paragraphs.

Time was not available for a detailed examination of the rock formations exposed above Horseshoe Creek. The purpose of the examination was primarily concerned with placer deposits, and of the formations only in so far as they might affect the latter.

It was, however, noted that at the mouth of the South Fork andesitic volcanics are exposed, which show little evidence of structure. Similar rocks are exposed instream on the road at this point. In the canyon 2 miles below Germansen Lake the formation exposed consists of schistose rocks.

From Horseshoe Creek down-stream the formation exposed by the Germansen River consists of alternating bands, usually some hundreds of feet thick, of schistose sediments and rocks believed to be mainly volcanics. These rocks strike about north 75 degrees west and dip mainly south-west, occasionally northerly, at about 60 degrees, and are considered to be of Palæozoic age by the Geological Survey of Canada. The sediments are argillites and limestones. The argillites pass into phyllites and are intruded by an acidic dyke in the 1933–34 hydraulic pit (on the left bank of the river) of Germansen Mines, Limited. The rocks, believed



Germansen River. Plan showing Property of Germansen Mines, Ltd., and Location of Leases. From Company's Plan.

to be volcanics, weather to a rusty-red colour, show frequent evidence of intense hydrothermal alteration, and, in places, large patches of green-coloured mineral, presumably chlorite. Samples of the latter were analysed and contained an amount of nickel under 0.1 per cent. Frequently these rocks contain numerous quartz gash-veins, some of quite large size. Some of these are barren; some are mineralized with pyrite and a little galena; and others mainly with freibergite. The volcanics in places are intrusive into the sedimentary rocks, and some at least appear to be sills. Only a few quartz veins are known to occur in the sedimentary rocks. One of large size, mineralized with pyrite and chalcopyrite, in argillite, is exposed by the river below Plug Hat Creek. The only quartz veins in the Manson section known by the writer to show commercial gold values are the gash-veins containing freibergite, exposed by the river. There is therefore ample evidence that the formation eroded by this river was capable of supplying gold for the formation of commercial deposits of placer on bed-rock in Tertiary times, but it is, however, most important to note that no placer deposits of any importance have been discovered either by early or present-day workers *above Little Slate Creek.*

At Ah Hoo Creek a belt of serpentine quite well mineralized with pyrrhotite is cut by the river. A sample assayed: Gold, trace; nickel, 0.18 per cent.* Below this point placer deposits usually contain small amounts of platinum.

Placer occurrences on the Germansen and Manson Rivers are difficult to decipher, for the region abounds in rare topographical features, which appear at unexpected places. Highly detailed field-work is necessary to interpret the topographic features correctly. Certain features appear to have a bearing on placer occurrences on both rivers—namely, McCorkell, Big Wolverine, and Slate Creek Valleys. The position of McCorkell Valley is subsequently explained in this report. Big Wolverine Valley is a large valley containing Big Wolverine Creek and the Wolverine Lakes, trending north-west and south-east, and continuous between the valleys of Manson and Omineca Rivers. It seems unlikely that the correct solution of placer occurrence on either river will be found without consideration of these features and their possible bearing on both.

The remarkable and similar great bends exemplified by the Germansen River, and its near neighbour the Manson River, invite the suggestion that such are possibly due to stream-piracy in Tertiary times, to which possibility attention is drawn in the Annual Report for 1933 on pages 108 to 110. Such a postulatory view may not be entirely correct, but as the surface of Wolverine Lake is about 30 feet *below* the level of Manson River at the mouth of Dry Gulch, and as Big Wolverine Creek flows north in this valley, it is evident that the waters of Manson River about this point were *very* nearly captured by the Omineca River in Tertiary times.

While the hypothesis of stream-piracy adds a certain amount of clarity to placer occurrence, it is rendered evident by examination that the Germansen River occupied more than one channel in Pleistocene times, and much headway cannot be made with correlation of the various channels occupied by this river until further investigation has been carried out.

To consider the chief topographic features of the Germansen River previously enumerated, and their significance in relation to placer deposits:—

The deep canyon, topographic feature (A), is probably of post-Glacial age, although cutting may have commenced in inter-Glacial times. The position of the river in late Tertiary times is indicated as being immediately south of the canyon. Indications are that the South Fork in Tertiary times occupied a channel just east of its present position near its mouth. After receiving its tributary at this latter point the Germansen River then, it is assumed, cut diagonally across the present position of its valley, occupying the buried channel indicated as underlying topographic feature (C). The large bank of gravels cut by the river at this point is a conspicuous feature and can be seen from a great distance. Time was inadequate for detailed examination, which might or might not afford some information as to depth to bed-rock. The subsequent down-stream course of this channel, apart from the fact that it must lie deeply buried under the upland plateau in this region, is unknown. Whether it has any connection with the channel indicated as lying within the depression occupied by Mill Creek near the river, topographic feature (E), or with the channel uncovered by Messrs. Ward and

* Small percentages of nickel have been found in serpentine rocks from many places in British Columbia.

Bauer above Plug Hat Creek, must remain a matter of conjecture until further investigation has been carried out. The direction of flow of the South Fork, and the maturity of relief of its valley, topographic feature (B), lends considerable colour to the view that this was the stream which worked northward, in Tertiary times, from the Omineca River, robbing a postulated Manson River rising in Germansen Lake and flowing east by way of Slate Creek Valley, topographic feature (F).

The McCorkell Valley, topographic feature (G), is a wide valley of mature relief extending from the Manson to the Germansen River Valley. In the latter the floor of the McCorkell Valley coincides with an extensive flat flanking the right bank of the river and 250 feet above it. According to the stream-piracy hypothesis, this valley was occupied by a northward-flowing stream, and investigation by Germansen Mines, Limited, to which company the matter is of direct importance, points to the likelihood of a gold-bearing channel therein. The point of emergence in the present Germansen River Valley may be indicated by the glacial clay-bank on the right bank of the river about 2,000 feet below Ah Hoo Creek. Kerr* considers it likely that the Manson River at one time flowed northwards through this valley. This view, it should be noted, also postulates a definite channel in the valley.

A sharp local bend, topographic feature (D), occurs about 3,000 feet above the down-stream end of the north-easterly-flowing part of the Germansen River. At this point a gap in the rock wall on the north side of the valley is occupied by a gravel-bank, and the indications are that a former deep channel trends instream. Its exact down-stream course is at present quite indeterminate, but it may have some connection with another deep channel found at the instream edge of the 1933–34 hydraulic pit of Germansen Mines, Limited, on the left bank of the river, shown on the accompanying map, or possibly also with the deep ground apparently discovered by early miners on the left bank of the river at the old townsite of Germansen. This must remain a mere conjecture until further investigation is made.

Topographic feature (H) is essentially indicative of the existence of a buried channel instream in the left bank of the river.

The low-lying rock benches and other benches, and part of the bed of the river, were extensively worked by the earliest miners. Early workers also apparently sensed the significance of high benches near Plug Hat Creek. Following the exhaustion of the more obvious, and doubtless rich, pay-gravels, the region was deserted apparently for the Cassiar District, and lay idle for many years. The ditch-line now used by Germansen Mines, Limited, it is stated, was originally constructed thirty-five years ago by W. Kenton, who also constructed camp buildings close to the present camp of the company, installed a hydraulic plant, and carried out a considerable amount of hydraulicking on the rock-bench ground, on the right bank of the river, in this vicinity. More recently, Ah Lock installed, single-handed, a small hydraulic plant just above the old townsite of Germansen, which has since been operated each year. Operations on a larger scale were commenced in 1931, after investigation by R. C. and A. A. McCorkell, by Germansen Placers, Limited, which company acquired the ground now under operation by Germansen Mines, Limited. The activities of the latter, and the recent discovery near Plug Hat Creek of a large high channel by Messrs. Ward and Bauer, have been the means of directing attention to the potentialities of the placer deposits of this river.

Placer deposits on this river that are now being worked, or have engaged the attention of earlier operators, are of the following types:—

(1.) Deposits on low-lying gravel or rock benches and in the bed of the river. Most, if not all, of these are of post-Glacial age and form the type of deposit extensively worked by the earliest miners.

(2.) Deposits on rock benches lying at an elevation of about 35 feet above the river and overlain by much glacial debris.

(3.) Placer deposits in deeply-buried channels lying entirely without, but *above* the river.

(4.) Deposits in a channel system, deeply buried, *below* the level of the river.

As previously mentioned, all the most important placer deposits occur in the north-westerly-flowing part of the river. Inasmuch as gold occurrence on this river is indicated as being of strictly local or closely-local origin, the previous fact mentioned quite possibly indicates that in its upper reaches the river does not cut a terrain that is appreciably auriferous.

* Kerr, F. A., Geological Survey of Canada Summary Report, 1933, Part A (page 22A).

It is quite possible that many low-lying benches and parts of the river-bed remain that can be profitably worked. Greater importance, however, attaches to deposits of the types (2) and (3), by reason of the indicated extent of these, their gold content, and the fact that they can be so readily hydraulicked. Moreover, the abundant water-supply that can be made available from this river, and its large tributary, the South Fork, under a good head, renders it obvious that hydraulicking can advisedly be undertaken on a major scale, and therefore at low cost, when sufficient yardage of requisite average value has been proven.

It is rendered evident by examination that the river occupies, almost throughout the length in which placer has been discovered, a post-Glacial channel. Concentrations of placer in the bed of the river and on adjacent low-lying benches, both gravel and rock benches, are apparently due to the post-Glacial waters cutting across a former channel. Among deposits of this class almost completely worked out by the earliest miners may be mentioned "Holloway's Bar" at Ah Hoo Creek, and the very extensive low-lying rock benches which occur on the right bank of the river between Mill Creek and the head of the lower canyon.

Rock benches at and above 20 feet above the river are overlain, usually quite heavily, with glacial material. Immediately overlying bed-rock there is usually a more or less cemented layer of pieces of shattered bed-rock, and fine gravel, overlain by imbricated gravels, some very coarse, derived almost entirely, save for boulders of granodiorite, from local rocks. Resting on the gravels is more or less silt, which is capped by up to 50 feet of boulder-clay, on top of which there is the usual post-Glacial run of gravel. Appearances in one channel, where both rims are exposed, on the lease of Messrs. Ward and Bauer are much the same as those just mentioned. In both cases there are indications that a powerful stream of water has flowed over the bed-rock for a relatively short time in the Pleistocene period. It does not, however, necessarily follow that the rock channel was carved in Pleistocene time, for if the channels were quickly carved in rock they would be gorge-like. High channels may, for instance, have been carved in this part of the river by drainage heading in the McCorkell Valley in pre-Glacial times; the deposits laid down therein being subsequently disturbed by glaciation, and finally resorted in Pleistocene times.

The character of the gold recovered from hydraulicking rock benches at 35 feet above the river on the property of Germansen Mines, Limited, may be described as coarse-flake gold, with a comparatively large proportion of nuggety gold. One nugget weighing 24 oz. was found in 1935. A nugget weighing 2½ oz. was discovered this year in the channel recently exposed on Messrs. Ward and Bauer's ground.

Generally speaking, it may be said that coarse gold features the placers of the Manson section, and its *individuality* indicates its closely-local origin. By individuality is meant that, as is so strikingly evident in the Cariboo District, each creek has its own particular gold which differs in fineness and in other respects from that of a neighbouring creek. Further, the indications are that the gold contents of pre-Glacial channels have been disturbed by glaciation rather than eroded. An exception is Big Wolverine Valley.

There is evidence at several places of deeply-buried channel-segments lying below the Germansen River; near the up-stream end of the property of Germansen Mines, Limited, at the point shown on the map, at the sharp local bend of the river, topographic feature (D); at the 1933–34 hydraulic pit of this company on the left bank of the river; and at the old townsite of Germansen. Some years ago at the last-mentioned point it is stated that a shaft was sunk to a depth of 35 feet below the river, with encouraging results, but ingress of water prevented further work. Little is, however, known of these deep channels.

In the light of present developments, very little correlation is possible in connection with the various channel-segments exposed.

It is evident that the constituents of the gravels overlying the cemented material on bed-rock were derived largely from local rock formations. Foreign boulders are composed almost entirely of granodiorite, indicating a south-eastward movement of the ice-sheet in this region.

Germansen Mines, Ltd.

This company was incorporated in 1934, with registered office at 716 Hall Building, Vancouver, for the purpose of acquiring and operating placer-mining leases on the Germansen River formerly held by Germansen Placers, Limited. It is understood that the property now comprises sixteen leases covering the bed and benches of the river for practically the entire distance between Little Slate and Mill Creeks, and that two additional leases on the latter creek are under application.

The means of access, topographic features and their significance, and the formations exposed are fully described in the introduction to this area, and will not be further discussed, save for brief mention of topographic features designated by the letter assigned to the reference cited.

The types of placer occurrence exemplified on this property are as follows:—

(1.) Placer deposits on low-lying benches and in the bed of the river.

(2.) Placer deposits lying on the extensive system of rock benches situated at an elevation of about 35 feet above the river, which are readily amenable to mining by hydraulicking and are probably of greater importance than (1).

(3.) Placer deposits in a deeply-buried channel system below river-level.

The rock benches mentioned are overlain by glacial deposits and represent former channels. The placer deposits in the bed of the river and on low-lying benches, many of which were extensively worked by the early miners, are presumably due to the concentration effected by post-Glacial waters in cutting across former channels.

With regard to the deeply-buried channels below the level of the river: Definite evidence of a channel below the bed of the river was afforded in the course of hydraulicking in the 1933–34 pit on the left bank, immediately instream from the pit. The up-stream continuation of this channel quite possibly occurs instream from the rock-rim of the river as far as the sharp bend above this point. Topographic feature (D) is presumably the up-stream end of this channel. Topographic feature (E) clearly indicates an extensive channel-segment quite possibly buried wholly instream from, although closely adjacent to, the river, but no evidence of the depth to bed-rock is exposed. The assumed Tertiary channel mentioned in the introduction, and indicated on the map, *may* of course be found on this company's property, but present data are inadequate to enable an intelligent opinion to be formed.

After investigation by R. C. and A. A. McCorkell prior to 1931, this ground was acquired by Germansen Placers, Limited, a company incorporated in 1931. In that year the extensive construction necessary for the installation of a hydraulic plant was commenced. Water was brought in from the head of the canyon, 2 miles below Germansen Lake, and conveyed by flume across the South Fork. The old ditch-line constructed many years ago was repaired and utilized from this point onward. Hydraulic operations were commenced at the end of the 1932 season and continued the following year. In 1934 Germansen Mines, Limited, acquired this property and has since continued operations. (Annual Reports of Minister of Mines, 1932, 1933, and 1935; also Geological Survey of Canada, Summary Report, 1933, Part A.)

At the time of examination in August the company was engaged in hydraulicking gravels overlying a rock bench, situated 35 feet above the river on the right bank, at the point indicated on the accompanying map. A pit had been opened up for a length of 675 feet fronting the river, with an average width of 150 feet. The maximum height of the pit-face was somewhat over 80 feet, and the following succession of strata was exposed from the top downwards: Several feet of post-Glacial gravels; about 50 feet of blue and red boulder-clay; 2 feet of indurated silt; about 25 feet of imbricated gravels; cemented large pieces of shattered bed-rock and fine gravel immediately overlying a hummocky bed-rock of argillite. Gold is contained in the gravels overlying the cemented material, more especially in the coarser gravels; in the cemented material overlying bed-rock; and in the cracks and crevices of the latter. The gold is in the main coarse, both nuggety and somewhat flat in form. A nugget about 24 oz. in weight was recovered in the course of hydraulicking in 1934 on a similar bench up-stream on the opposite side of the river. The pebbles and boulders in the gravels overlying the cemented material are almost entirely of local origin. Foreign boulders are almost entirely of granodiorite.

An important feature in regard to the age of the gravels is exhibited in this pit and also in the up-stream pit. Joints from 2 to 3 inches in width in the bed-rock extend upwards through the gravels, but not through the boulder-clay. These joints are filled with fine silt, proving that they were opened *after* deposition of the gravels. The joints are assumed to have been opened by frost-action, evidence to the contrary being absent; therefore the gravels must be pre-Glacial or early Glacial.

The up-stream continuation of this channel seems likely to be of considerable length, as rock flanks the river for about 3,500 feet up-stream from this point, and where the rock rises 35 feet or more above the river the channel may lie instream. Although the up-stream part

has been worked to some extent by earlier operators, there is much to suggest that this work did not penetrate sufficiently far instream. The down-stream extent, likewise the width of the channel, is as yet unknown. This channel is of particular interest because the extensive flat, previously mentioned, flanks the bank of the river in this region at an elevation of about 350 feet. There is much to suggest that at one time McCorkell Valley was occupied by a stream of water. About 750 feet instream from the pit, and 200 feet above its floor, a slough is situated on the flat mentioned, and immediately behind the slough volcanic rocks forming the valley-rim are exposed. There is therefore plenty of room for a channel of considerable width at this point, which may be near the junction of two channels. Valuable information can readily be obtained by piping in such a way as to cross-section the channel. A possible point of emergence for a channel on this side of the river is indicated by the glacial clay-banks on the right bank of the river about 2,000 feet below Ah Hoo Creek.

Another point of particular interest is the region on the left bank of the river about 1,200 feet below Ah Hoo Creek. A high-line has been set up at this point to mine a low-lying bench, on which the values are stated to be good, which flanks the left bank of the river. Behind the low-lying bench argillites and volcanic rocks rise sharply to a height of 40 feet, and on these rest glacial gravels which slope steeply to an extensive flat 200 feet above the river. The width of the flat is about 500 feet. It extends up-stream for a considerable distance and down-stream merges in a wide depression parallel to the river, occupied by the lower part of Mill Creek (this creek is incorrectly shown on existing maps, but its approximate position is indicated on the accompanying map). There is every indication that a former channel of the river lies buried instream at this point for a considerable distance. Save locally, its exact course cannot be determined from present exposures, nor is it known at what depth bed-rock lies. The company has installed a pipe-line and constructed a ditch-line for conveyance of water from Mill Creek to supply wash-water for their high-line operations. On completion of the latter it is their intention to commence hydraulic operations at this point.

The company derives its main water-supply from the Germansen River at the head of the canyon above the South Fork. From the intake the water is conveyed by ditch and flume for several miles to the point of use, where the head at present is about 200 feet. There are certain points on the ditch-line where much trouble is experienced each year, especially in spring, owing to sloughing of banks. While an excellent water-supply is available, only a part is utilized. While the writer has not full information of the exact recoveries effected to date, judging from the results secured last year, and in view of the potentialities apparent, there would seem to be every justification for hydraulicking up to the maximum capacity of the existing ditch-line. At the time of inspection only one monitor with a 4-inch nozzle was in operation. More active hydraulicking could readily proceed simultaneously with the high-line operations just started. It is understood that the improvements in the ditch-line necessary to accomplish the objective mentioned are under consideration by the management.

Leases of Albin Hagberg.

Two leases, held by Albin Hagberg, are situated at the old townsite of Germansen, and cover mainly the ground on the left bank of the river for a distance of about 1 mile, as shown on the accompanying map. The property is reached by a foot-trail from the end of the road from Slate Creek to Ah Hoo Creek, which follows closely the right bank of the river to a foot-bridge across the latter at the upper end of the property.

The chief topographic feature of the up-stream lease is a long and narrow rock bench, about 20 feet above river-level, flanking the left bank of the river in the long canyon in this region. At the down-stream end there is an embayment; the rock bench merges in a gravel bench at the same level; and the river swings sharply east, entering a narrow rock canyon with vertical walls.

Instream, the flat is terminated, save at the embayment, by steep banks of glacial debris which rise to the plateau-level. In the immediate vicinity of the embayment there is a steep rock-outcrop continuous with the glacial banks. The right bank opposite the rock bench rises steeply from the river's edge and is covered with timber. The remainder of the ground except the rock bench is also well timbered, save locally.

The formations exposed consist of intercalated schistose sediments and metamorphosed volcanics. The latter contain some quartz gash-veins exposed on the rock bench. The former consist of cream-coloured limestone and argillite.

The rock bench undoubtedly represents a segment of a former channel, but at the lower end, where, as stated, the rock bench merges in a gravel bench at the same level, there is apparently a still deeper channel closely adjacent. It is stated that a shaft was sunk at this point by early miners to a depth of 35 feet, considerably below the river-bed, and that good values were struck in gravels, although ingress of water prevented further work. The embayment and the existence of a rock-rim instream, and other topographic features also, indicate that a channel lies buried instream on the west side of the canyon-wall in this region. The level of this rock bench is considerably below that of the bed-rock of the channel about 80 feet above the river recently uncovered south of this point on the lease of Ward and Bauer.

The lower part of the rock bench was overlain apparently by post-Glacial gravels which were extensively worked by early miners. The upper part, however, is overlain by a great thickness of glacial debris and boulder-clay.

The ground was acquired originally by Ah Lock, who in 1926 installed, single-handed, a small hydraulic plant, water being derived from the creek named on the map Ahluk Creek Small-scale hydraulic operations have been subsequently carried on for some years, both by the original owner and by the present owner, who acquired the property in 1934. (Annual Reports of the Minister of Mines for the years 1927, 1933, and 1935; also " Placer-mining in British Columbia," Bulletin No. 1, 1931.)

At the up-stream end the bench has been piped off over a river-frontage of about 275 feet, and to an average distance of about 75 feet from the river. At the up-stream extremity the rising rock indicates the end of the channel-segment at this point. Topographic indications do not suggest a great extent of profitable ground instream. The pay-gravels immediately overlie bed-rock and are heavily overlain by glacial debris and boulder-clay.

The gold occurs chiefly in coarse flakes, although some coarse nuggety gold has been found. It is understood that the ground has proved quite productive.

The lower part of the bench, so far as it is known, was worked off largely by early miners. It is difficult to appraise the potentialities of the deep ground, which, as mentioned, lies buried instream from the river, at the lower end of the rock bench on the lower lease.

Lease of A. L. Ward and J. Bauer.

This lease is situated immediately south of Plug Hat Creek on the left bank of the river at the top of the wall of the canyon in which the river is confined. It is reached by a foot-trail from the end of the wagon-road at Ah Hoo Creek. The chief topographic feature is the rolling plateau-like surface which characterizes the top of the rim of the river-valley in this region. The ground is covered with light timber. Here is a large channel, buried to a depth of about 135 feet, with bed-rock about 80 feet above the river-level. Both rock-rims of the channel are clearly exposed and the width from rim to rim is about 475 feet. The east rim of the channel is immediatetly adjacent to the canyon in which the river is confined. The down-stream continuation of the channel is clearly exposed by Plug Hat Creek, which cuts across it, but there is no obvious indication of its position up-stream. The rock formation exposed in the pit is schistose argillite.

The potentialities of gravels overlying the rock instream from the canyon in this region were apparently perceived by early miners, who brought in water from Plug Hat Creek by ditch-line for the purpose of washing them. The extent of the old workings seems to indicate that good values must have been found. In recent years very little work was done until the ground was acquired by the present owners in 1935, who installed a hydraulic plant that year, conveying water from Plug Hat Creek by utilizing the old ditch-line. The continuation of operations this year resulted in exposure of the channel. (Annual Reports of the Minister of Mines for the years 1927 and 1935; also " Placer-mining in British Columbia," Bulletin No. 1, 1931.)

Although bed-rock is not actually exposed, the slope of the rims indicate that it is not likely to be more than a few feet below the floor of the pit. The width of the channel from rim to rim is about 475 feet and the height of the pit from floor to top of face at the centre is about 135 feet. In the more central part of the pit the section consists of: Shattered pieces of bed-rock, more or less cemented together; about 15 feet of gravels bearing evidence of strong water-action; about 6 feet of indurated silt; about 40 feet of silt and fine gravels; about 60 feet of blue boulder-clay; and finally on top of the clay the customary post-Glacial run about 10 feet in thickness. The boulder-clay breaks up very easily for this kind of

material and is readily disintegrated by the monitor. The section of unconsolidated materials overlying bed-rock is in many respects similar to that exposed in the hydraulic pit of Germansen Mines, Limited. A nugget weighing about 2½ oz. was recovered this year from the gravels on the east rim, but at the time of examination little or no further work had been done.

So far as can be determined from present exposures, the gravels overlying bed-rock are glacial, but it does not therefore necessarily follow that the channel was carved in Pleistocene times. It may have been cut in pre-Glacial times, and the gravels of that period subsequently disturbed by ice-movement and later resorted by glacial streams. The proportions of the channel, and the fact that it has been found to contain gold of the character mentioned, amply justify its further close investigation. Added to this, its position high above the river affords excellent dump facilities for hydraulicking. It is evident, however, that very little headway can be made with the present inadequate water-supply from Plug Hat Creek, unless this can be improved. Mill Creek is much larger, but is utilized in part at the present time, and it is not known just what amount of water could be obtained from this source. Assuming that investigation should afford justification for the expense involved, a large water-supply could be obtained from the Germansen River. There appears to be no near topographic indication of the exact up-stream course of this channel, which must remain largely a matter of conjecture pending further investigation.

It is understood that subsequent to examination this year further leases were staked, and also that the property was acquired by C. F. de Ganahl.

(NOTE.—All elevations given in the report on the Germansen River, and in reports of individual properties thereon, are aneroid determinations.)

LOST CREEK AREA, MANSON RIVER.

One week was occupied in an examination of the Manson River in the vicinity of Lost Creek, and the region adjacent to the latter.

The region may be readily reached by the road now in course of construction from Fort St. James to the Manson section. The local wagon-road system of this section extends to the mouth of Lost Creek. Further particulars of the means of access will be found under "Germansen River" in an earlier part of this report. Alternatively, the region may be reached from Fort St. James by aeroplane, landing being effected on either Lower Wolverine Lake or Upper Manson Lake. The latter is preferred by aviators.

In the vicinity of Lost and Skeleton Creeks the Manson River flows almost due east and rock benches flank both its banks. The one on its right bank is quite extensive and some hundreds of feet in width near Lost Creek, and the height above the river varies up to 50 feet. This definite rock-bench area ends about opposite Dry Gulch, and down-stream from this point the rock-rim of the river-valley rises at the back of extensive bars almost vertically to a height of about 30 feet, and then flattens suddenly to ground sloping gently upwards, but underlain by rock at shallow depth. This slope merges farther down-stream in extensive gravel flats.

Conspicuous features are the two large valleys, McCorkell and Big Wolverine, which extend through to the Manson River Valley respectively from the Germansen and Omineca River Valleys. These cross-valleys are closely parallel, about 2 miles apart, and are separated by the mountain known as Bert's Peak. The former is about 60 feet above the Manson River, but the surface of Wolverine Lake, situated at the south-east end of the latter, is about 30 feet below the Manson River at the mouth of Dry Gulch. These valleys and their possible significance are discussed under "Germansen River" in this report.

An extensive, wide depression in Skeleton Mountain, at an elevation of 335 feet above and on the south side of the Manson River, trends more or less parallel to it. Lost Creek, flowing northerly, emerges from a rocky gorge in the higher mountain-slopes, crosses this depression, and enters a narrow deep rocky gorge on the north side of it. The creek is confined in the latter gorge, which trends north-easterly, until it ends abruptly at the back of the extensive rock bench, previously mentioned as flanking the right bank of the Manson River in this region. Flanking the top of this last-mentioned gorge, on the east side, hummocky morainal ground slopes gradually from the level of the large depression in Skeleton Mountain to the bench paralleling the Manson River. The morainal ground, occupied by a small lake in its northern part, passes diagonally across the lower part of the valley of Skeleton Creek,

which above this point is largely unfilled. This moraine is considered pertinent to placer occurrence and its seeming significance will be discussed later. On the west side of the gorge broken morainal ground extends to the flanks of the adjacent mountain, known locally as Lost Creek Mountain. A depression trending parallel to the gorge was possibly formed by post-Glacial streams.

The region is in main well timbered, save that rock benches have been partly cleared by miners, and the lower slopes of Skeleton Mountain have been burnt over by bush fires.

The rock formation is well exposed on the Manson River and in Lost Creek Gorges, and is practically the same as that cut by the Germansen River below Horseshoe Creek (an account of which will be found under "Germansen River" in this report). There is the same repetition of alternating bands of schistose sediments and metamorphosed rocks considered to be chiefly volcanics. The latter evince the same frequent development of quartz veins; some mineralized with pyrite and galena, but similar quartz veins, mineralized with freibergite, have not been seen in this area by the writer, although they may exist. On the south-western slopes of Bert's Peak are frequent outcrops of gneissic quartz diorite, which also outcrops at several points between the head of Elmore Gulch and Lost Creek on the south side of the Manson River. Serpentine containing asbestos is exposed at the head of Elmore Gulch. It is evident that the formations eroded in the region under description are not unfavourable as a source of material for the formation of bed-rock placer deposits in Tertiary times.

Early mining operations in this region were concerned mainly with the quite extensive deposits on Lost Creek, and on the rock benches flanking the Manson River. Judging from their extent, the former appear to have proved very profitable and the latter also productive. Later operations include the hydraulic operations of G. W. Otterson on the left bank of the Manson River; those of McKinnon on the upper part of Lost Creek above the large depression previously mentioned in Skeleton Mountain; and the driving of certain adits in the right bank of the lower part of Lost Creek by W. B. Steele and J. Mullan. More recent still was the installation of a drag-line on the Manson River at the mouth of Dry Gulch, its short-lived operation in 1931, and the drag-line operations of Omineca Placers, Limited, at the south-east end of McCorkell Valley. Present operations engage the activities of two companies and several individuals, with the result that attention has been again limited to the potentialities here apparent. ("Placer-mining in British Columbia," Bulletin No. 1, 1931; Annual Reports of the Minister of Mines for 1933 and 1935; Geological Survey of Canada, Summary Report, 1933, Part A.)

Recent examination suggests that two clear-cut major mining possibilities yet remain: (*a*) The bed of the Manson River in this region and (*b*) the buried pre-Glacial channel of Lost Creek. In addition to these are the unworked parts of rock benches on the Manson River and deposits overlying the gently-sloping rock-rim on the south side of its valley. The coarseness of the gold recently found in the two last-mentioned deposits also invites and justifies further investigation, although their importance cannot be quite as clearly perceived.

The rock bench on the right bank of the Manson River in the vicinity of Lost and Skeleton Creeks is, near the river, overlain with shallow post-Glacial gravels, which were largely worked by the early miners. Instream, however, it is evident that the post-Glacial waters did not cut down to the rock as the superficial post-Glacial deposits rest on glacial material overlying bed-rock. Recent investigation apparently shows, however, that values in coarse gold also occur in the lowest stratum of the glacial deposits.

The rock benches clearly represent former channels of the river, and as it has been demonstrated that these benches were overlain with auriferous material, it is a logical inference that gold will be found in the bed of the river at the intersections with its former channel. It is unlikely that the depth to bed-rock in the present river is great at any point in the part under discussion, but the commercial aspects are dependent upon the extent of the values, which can only be accurately determined by Keystone-drilling. It is understood, however, that systematic drilling was carried out in the bed of the river prior to examination this year by Yukon Border Placer Golds, Limited, between Dry Gulch and somewhat above Slate Creek. The results are not known to the writer, but it is understood that a company, Northern Placers, Limited, has recently been incorporated for the operation of this ground.

The exact significance of the extensive depression in Skeleton Mountain occupied by Mosquito and other smaller lakes is not quite clear. It was suggested in the Annual Report

for 1933 that it might represent a Tertiary channel of the Manson River. Be that as it may, the other topographic features surrounding Lost Creek, coupled with available information as to adits formerly and recently driven in the right bank, strongly indicate that a pre-Glacial channel of this creek lies buried in its right bank. The moraine of the glacier which at one time occupied this channel can be perceived immediately east of the gorge the creek now occupies, trending almost parallel to the latter, but extending across the valley of Skeleton Creek, which is largely devoid of glacial debris in its lower part. The descent of the glacier occupying the pre-Glacial channel of Lost Creek apparently dammed the waters of Skeleton Creek, a morainal lake being formed temporarily. The former position of this lake is now indicated by swampy ground, the drainage of which is sealed by the moraine of the glacier mentioned. Skeleton Creek, its original outlet being blocked, succeeded in cutting completely through the moraine at a point west of its former channel, and followed this course until it was rediverted into its original channel by the placer-miner. The post-Glacial rejuvenation of Lost Creek resulted in the creek incising a deep gorge almost paralleling and immediately west of its former channel, but at one or two points it cut into the left rim, giving rise to the post-Glacial deposits in the gorge, which were almost completely worked by early miners. The latter apparently perceived the fact that the source of the interrupted run of gold was lateral, if they did not grasp the full significance of the surrounding topographic features, and various adits were run in the right bank of the creek in search of the lost channel. Hence, doubtless, the apt name originally given to this creek. As determined by pacing, the length of the gorge is 5,800 feet; it ends abruptly at the instream edge of the extensive rock bench paralleling the Manson River, about 1,500 feet from the mouth of the creek. Adits were driven at points 1,075 feet, 1,925 feet, and 4,045 feet respectively distant from the mouth of the gorge. Another adit, at 4,495 feet from the point mentioned, was driven by R. Dunsmore this year. Information is available only concerning the two last mentioned. That at 4,045 feet from the mouth of the gorge was driven by W. B. Steele and J. Mullan somewhat over twenty years ago. Practically all the information available concerning it was kindly supplied by W. B. Steele. He states that it was driven a distance of 550 feet before encountering bed-rock. At this point pay-gravels were struck and a vertical raise (118 feet in length) was put through to the surface for ventilation. The adit was then advanced a further distance of 200 feet. Where pay-gravels were encountered the ground was drifted over a width of about 40 feet, and gold to the value of several thousand dollars is stated to have been recovered.

The collar of the air-shaft is situated about 200 feet east of the gorge and about 80 feet above Lost Creek. The upper part of the air-shaft is still intact, but the workings are caved and inaccessible. This year R. Dunsmore drove an adit 30 feet long from the creek-level in the gorge into the right bank of the latter at a point about 200 feet north-west of the air-shaft. This adit was started in rock but ran into gravels. Accordingly, a shaft was sunk in the gorge a few feet up-stream to a depth of 25 feet, and it is stated that a drive from this shaft, 22 feet below the collar, in a distance of 10 feet broke into pay-gravels. This working could not be fully examined as it was bulkheaded.

As determined by aneroid, the fall from the head to the mouth of this gorge is 290 feet; the length is, as has been mentioned, 5,800 feet; that is, the fall is 5 per cent. Available facts indicate that the bed-rock of the pre-Glacial channel is about 25 feet below the gorge. It seems entirely reasonable to suppose that the gorge has cut sufficiently low to reach the auriferous gravels in the pre-Glacial channel as far as the lowest adit (below which there was no "pay" in the gorge), 1,075 feet above the mouth. Therefore, presumably, the bed-rock gradient will be much the same as that of the gorge, and the outlet of the channel should be found, east of Lost Creek Gorge, by Keystone-drilling, for example, at an elevation of about 25 feet above the river, at the back of the rock bench instream from the latter.

The upper part of Lost Creek above the large depression in Skeleton Mountain is also largely confined in a rocky bed for a considerable distance. The McKinnon hydraulic operations were carried on at one place where the right rim of the post-Glacial channel has been entirely eroded, and where the pre-Glacial channel lies buried in the right bank of the creek. Owing to extensive sloughing of the pit it was not possible to discern whether bed-rock of the pre-Glacial channel had been reached, nor is it known what amount of gold was recovered as a result of these operations.

Considering this creek as a whole, irrespective of the fact that the ground is not vested in one ownership, available information inclines the view that it may constitute a hydraulic enterprise of some magnitude. The depth to bed-rock does not seem likely to prove excessive, and from the upper part of the Manson River doubtless an adequate water-supply could be secured. An all-important matter from the point of view of hydraulicking is that of dump facilities; that is, the height of the lower end of the buried channel above the river. This can best be determined by Keystone-drilling, although it is presumed to be considerably above the present bed of the river. Once this point is established a few cross-sections at higher points would afford the necessary additional preliminary information prior to hydraulic installation.

There is much to suggest that the values on bed-rock in this buried channel may prove sufficient to enable the channel to be profitably mined by deep-lead methods. Inasmuch as the ground covered is not vested in a common ownership, quite possibly this method will be followed in part at any rate.

Lost Creek Placer Gold, Ltd.

This is a private company, incorporated in 1936, with registered office at 826 Vancouver Block, Vancouver. The president is Bert McDonald. The property consists of placer-mining leases numbered 736, 737, 738, 739, 740, 741, and 818. Of these, five leases adjoin and cover the ground on the right bank of the Manson River for a distance of about 1½ miles, in the vicinity of Lost Creek, and also about the lower half-mile of the latter, including part of the probable position of its pre-Glacial buried channel. Two leases, Nos. 739 and 740, are situated on the north side of the Manson River and cover part of the extensive floor of Big Wolverine Valley adjacent to the river.

The means of access and the topography of that part of this property on the south side of the Manson River are described in detail in the general account of this area previously given.

The leases on the north side of the river cover Dry Gulch, a deep narrow cleft in the south-eastern extremity of Bert's Peak. The head of this gulch is level with the floor of Big Wolverine Valley. The latter, as determined by aneroid, is about 25 feet above the Manson River at the mouth of the gulch. The floor of the valley slopes downward towards Wolverine Lake, and the latter is considerably below the river-level at the mouth of the gulch. In spite of this fact, the lake is drained by Wolverine Creek into the Manson River, because the latter, about 1½ miles down-stream, falls below the level of the lake. Near Manson River the floor of Big Wolverine Valley is well timbered, but near the lake it is occupied by meadows.

The formation exposed on this property has been previously described. Three separate types of placer occurrence are exemplified:—

(1.) The lower part of the buried pre-Glacial channel of Lost Creek.

(2.) The unworked parts of the extensive rock bench flanking the right bank of the Manson River.

(3.) Post-Glacial concentration on the floor of Big Wolverine Valley.

The potentialities of (1) above have been discussed in an earlier section of this report.

The post-Glacial deposits on the rock bench flanking the right bank of the Manson River —(2) above—were extensively worked by earlier miners. The latter evidently discovered that at the instream part of the bench pay-gravels were underlain by glacial material and not by rock, as was the case nearer the river, and did not apparently work below the superficial pay-gravels. After preliminary investigation by Bert McDonald, the company installed a caterpillar steam-shovel with bucket of ⅞-cubic-yard capacity at the instream part of this rock bench, on the right bank of Lost Creek. The power-shovel, together with a caterpillar tractor and portable grizzly and sluice, constitutes a mobile digging and washing unit, which serves well the purpose for which it is intended. Water for sluicing is conveyed from Lost Creek by flume and pipe-line. At the time of examination, at the point mentioned, the face of the pit, 20 feet in height, exposed a thickness of from 3 to 8 feet of post-Glacial gravels overlying a thickness of 12 to 17 feet of mixed boulder-clay and glacial materials, resting on bed-rock. It was apparent that quite coarse gold was being recovered at this point, and that values exist not only in the post-Glacial gravels, but in the underlying glacial material.

At relatively small cost, the equipment described will be employed to test the remaining unworked parts of this rock bench. In the course of doing so it is possible that some useful information may be gained as to the exact position of the pre-Glacial channel of Lost Creek.

It is only by detailed testing that the potentialities of the floor of Big Wolverine Valley —(3) above—can be accurately determined. It is known that on the left bank of the Manson River below Dry Gulch an encouraging concentration occurs at various depths below the surface, on successive layers of indurated glacial material. There have been evidently active post-Glacial streams flowing throughout Big Wolverine Valley, and concentration due to resorting may be found at points away from the Manson River. This valley was probably subjected to "big valley" glaciation due to a south-eastward movement of the ice from the high mountains on the north side of the Omineca River opposite the north-west end of the valley. The bed-rock, the depth of which is not known, has therefore probably been scoured by ice. Dry Gulch was evidently rapidly incised. Cutting was possibly commenced in inter-Glacial times and subsequently completed. Up-stream from Lost Creek, about opposite the old *Bumble Bee* placer claim, an embayment in the left bank of the Manson River, coupled with an apparent gap in the rock-rim at this point, suggests that a channel-segment of the river possibly lies buried instream between this point and another in Big Wolverine Valley north of the head of Dry Gulch. Time was not available for close investigation of this point, which seems important.

Leases of R. Dunsmore and Associates.

It is understood that this property comprises three placer-mining leases and one placer claim on Lost Creek. The property immediately adjoins up-stream that of Lost Creek Placer Gold, Limited, and covers part of the probable position of the buried pre-Glacial channel of this creek. The address of the owners is Prince George. The means of access, topography, type of deposit, apparent potentialities, and underground workings are described in detail in the general account of this area previously given. At the time of examination, operations had been temporarily suspended pending installation of a pump to render possible further investigation at the point at which discovery of pay-gravels was reported. Investigation may also disclose some remaining portions of post-Glacial deposits that escaped the attention of early miners in the gorge.

Leases of S. Rosetti and A. E. Hayward.

Two placer-mining leases numbered 575 and 652, situated on the right bank of the Manson River down-stream from Skeleton Creek, adjoining the property of Lost Creek Placer Gold, Limited, are held by S. Rosetti and A. E. Hayward, of Fort St. James. The property is reached by foot-trail from the camp of the company named. The property is situated at the bend of the river where the direction of flow changes from due east to south-east. Instream from bars which flank the river at the bend, the rock-rim of the valley rises sharply to a height of about 30 feet above the river and then flattens to a gently-sloping rim, which merges down-stream in an extensive gravel flat. The ground is timbered.

Investigation has shown that this gently-sloping rim is underlain, at a depth of a few feet, by rock sloping roughly parallel to the surface in its lower extremity, but exhibiting a tendency to dip inwards at points more distant from the river, creating the idea of the existence of a possible channel trending more or less parallel to the river.

The mode of placer occurrence exemplified is that of concentrations immediately overlying rock, both in post-Glacial gravels and in gravels overlain by unsorted glacial material. The character of the gold is generally quite coarse, and a nugget of about 2½ oz. in weight was recovered this year.

Utilizing water from Skeleton Creek conveyed by ditch-line, by ground-sluicing and hand-mining, three pits have been opened up from the top of the sharply-rising rock-rim. These cover a river-frontage of about 700 feet and extend back from the edge of the rock-rim to a maximum distance of about 225 feet. The general direction of these pits is southerly.

It is understood that the ground was drilled this year by Yukon Border Placer Golds, Limited, but values encountered are not known to the writer. The large nugget was, it is understood, discovered subsequently.

While a definite channel has not been revealed, it has been demonstrated that coarse gold underlies glacial material, and further investigation is warranted. This can be accomplished by continuing instream the lower pits, which is the present intention of the owners.

(NOTE.—All elevations given in the report on Lost Creek Area, Manson River, and also in reports on individual properties therein, are aneroid determinations and are therefore approximate.)

Cottonwood River.

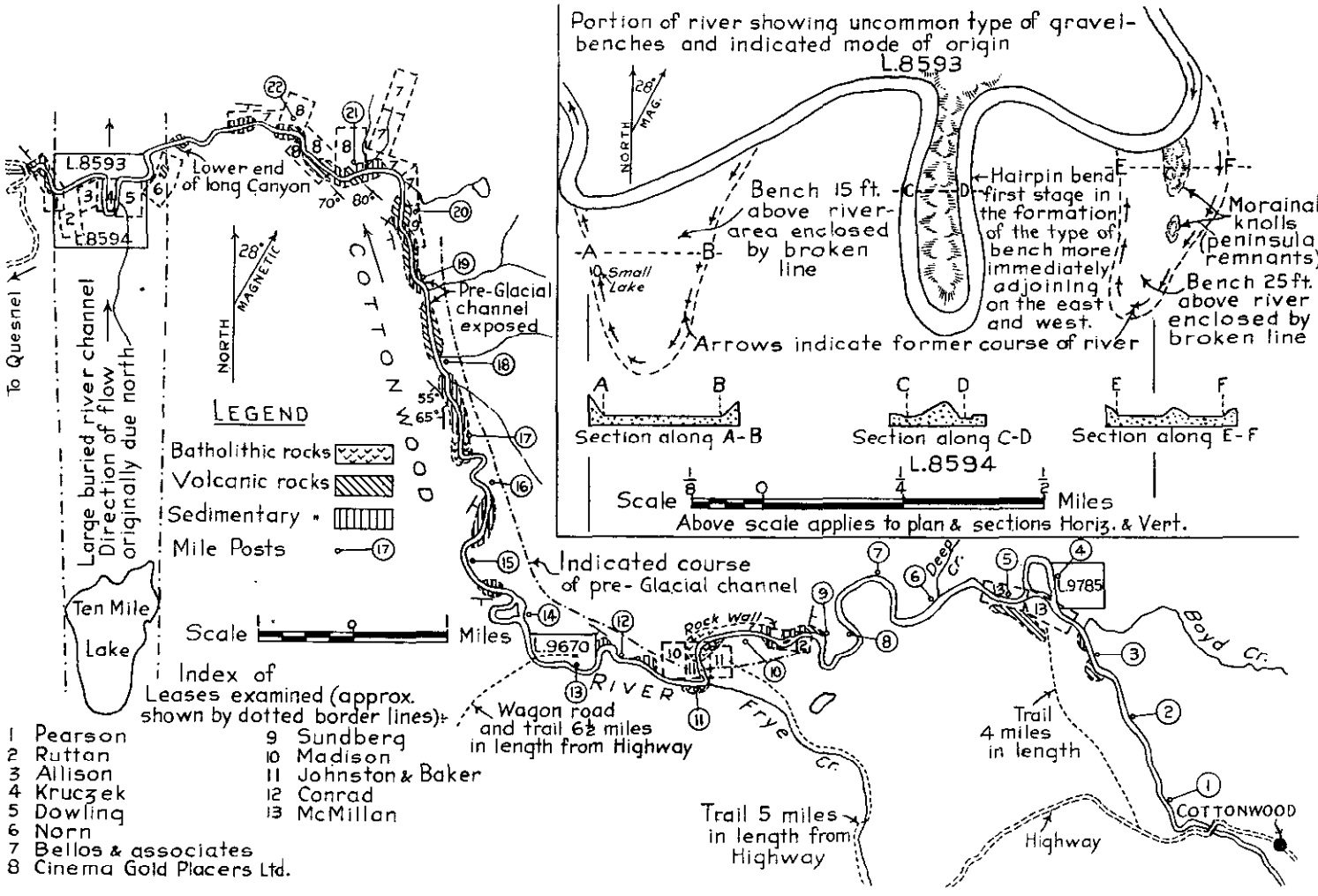
Placer occurrences along the Cottonwood River between the Quesnel–Barkerville and Prince George–Quesnel Road crossings, a distance of about 26 miles, were studied during the 1936 field season. The object of the field-work was not to examine every placer deposit along this part of the river, but to obtain sufficient information to afford a clear insight into the various types of placer occurrence and their mode of origin.

A traverse of the river from the bridge near Cottonwood to Mile 22 was made by the Department of Lands in 1923. At that time mile-posts giving distances from the bridge near Cottonwood down-stream were placed in position. The locations of these posts are shown on the accompanying map and they are used as reference points in this report.

The area immediately adjacent to the river is inaccessible by road or trail for any great distance, due to the very steep banks which flank the river and also to the numerous rock canyons through which it flows. A road passable for motor-trucks leaves the Prince George–Quesnel Highway at Cinema and extends for a distance of about 6½ miles to the plateau on the north side of the river. A horse-trail, known as "Coughlin's Trail," continues from the road following the plateau at some distance from the river to Pre-emption Lot 9670, where it descends to the river, and thence follows in places the river and in places the plateau to the road crossing near Cottonwood. The trail is in disrepair from Mile 9 to Mile 4. Access to the lower part of the river is by a foot-trail from "Cottonwood Hill" on the Prince George–Quesnel Highway. This trail crosses a sparsely-timbered flat adjacent to the highway, and then descends steeply to the left bank of the river, which it follows closely, terminating at the eastern boundary of Pre-emption Lot 8594. The central part of the river is conveniently reached by a branch road which leaves the Quesnel–Barkerville Road 7½ miles from Quesnel and, crossing the plateau in a north-easterly direction, ends at the rim of the river-valley. From this point a steep horse-trail leads to a ford across the river at the western boundary of Pre-emption Lot 9670. Trails to individual properties are described in the following reports on them.

The Cottonwood River has incised a valley to a depth of from 300 to 350 feet in the rolling, timbered Fraser Plateau. Between the Cottonwood Bridge and Pre-emption Lot 9670, the river meanders in a wide mature valley, with the single exception that it is contained in a rock canyon about 1 mile in length near the 10-Mile post. With this exception, rock-exposures near the river are not numerous in this part of the valley. Immediately down-stream from Pre-emption Lot 9670, the river makes a sharp bend to the north, its valley narrows, and it enters the first of a succession of steep-walled rock canyons. The last canyon is practically continuous for a length of nearly 4 miles extending from above the 20-Mile post to about a quarter of a mile above the north-east corner-post of Pre-emption Lot 8593. From the last-mentioned point to the western boundary of Pre-emption Lot 8594 the river has cut through a mass of glacial debris hundreds of feet in thickness, forming a remarkable hairpin bend, described in the body of this report. At the western boundary of Pre-emption Lot 8594 the river again enters a short rock canyon, about 400 yards in length, terminating at the bridge on the Prince George–Quesnel Highway.

Many of the canyons cannot be traversed throughout at any stage of the water owing to the precipitous nature of the walls, but ample rock-exposures were examined to show that the formations cut by the river consist of alternating bands of volcanic and sedimentary rocks. The bands are usually several-hundred feet in width. The sediments are chiefly thin-bedded argillites. They are considerably folded, strike mainly north-westerly with south-westerly dip, but both strike and dip vary. The volcanics are andesitic and contacts are very poorly defined. The aforementioned rocks are intruded at a number of places by batholithic tongues, and by stocks of considerable size at 10-Mile and 17-Mile Canyons. At the two latter points the batholithic rocks exemplify magmatic differentiation. Coarse-grained diorite, pegmatitic in places, exposed at the lower end of 10-Mile Canyon, passes into pyroxenite farther up the canyon. Porphyritic pyroxenite with phenocrysts of augite is exposed at 17-Mile Canyon. Pegmatitic diorite is also exposed on the left bank of the river at the 11-Mile post, and also on the right bank of the river a quarter of a mile up-stream from the 12-Mile post. Although the intruded rocks show considerable pyritization at different points, there is little evidence of the existence of quartz veins in the formation exposed by the river. A large vein of calcite is exposed in 10-Mile Canyon, and also a small seam of brecciated calcite mineralized with



Cottonwood River. Plan showing Location of Properties.

pyrite. It is, however, evident that the presence of ultrabasic rocks affords a logical explanation for the occurrence of metals of the platinum group, and the large amount of black sand and unusually coarse magnetite and hematite in placer gravels.

In considering placer occurrence, four chief features are evident:—

(1.) The indications are that that part of the valley where no rock is exposed, and almost exactly delimited as lying within Pre-emption Lots 8593 and 8594, is crossed at right angles by an ancient valley formerly occupied by a northward-flowing stream. It is believed that this ancient valley is quite possibly the down-stream continuation of the buried Tertiary Horsefly River Valley. (Refer to Annual Report for 1935, page C 27.) However interesting this supposition may be when considered in conjunction with the fact that the direction of flow of the Quesnel, Willow, and Bowron Rivers is in accord with a northerly- and not a southerly-flowing master-stream, its further discussion is not germane to this report, save that the pre-Glacial channel of the Cottonwood River mentioned later was probably a tributary of the ancient master-channel.

(2.) Topographic evidence indicates that a lengthy pre-Glacial channel-segment of the Cottonwood River lies buried immediately instream in the right bank, in the northward-flowing part between Pre-emption Lot 9670 and the point at which the river makes a sharp turn, thereafter flowing westerly, at the 20½-Mile point. An exposure about 500 feet long of what are believed to be pre-Glacial gravels was found on the right bank of the river about a quarter of a mile up-stream from the 19-Mile post. The creek, shown on the accompanying map, cuts down through the overlying glacial gravels and into these gravels. Bed-rock is not exposed.

In the absence of fossil evidence, the following criteria are considered as indicative of the pre-Glacial age of *river*-gravels: (*a.*) The *residual* character, whereby they should contain a large proportion of pebbles composed of a resistant mineral. (*b.*) Prolonged Tertiary erosion must have been accomplished at the loss of gradient, and therefore preserved Tertiary river-gravels are likely to be of uniform and medium size. (*c.*) The gravels are partly or wholly cemented, but this fact *per se* is by no means indicative of pre-Glacial age. (*d.*) The gravels underlie glacial gravels, which fact, considered in conjunction with the other features mentioned, is indicative of pre-Glacial age. The gravels in the aforementioned exposure are chiefly composed of medium-sized quartz pebbles, partly cemented and overlain by glacial gravels, and, therefore, according to the criteria given, are believed to be pre-Glacial.

(3.) The part of the river confined almost entirely in a long rock canyon between the 20½-Mile point and the eastern boundaries of Pre-emption Lots 8593 and 8594 is considered as being largely post-Glacial in age, although cutting may have commenced in inter-Glacial times. Placer occurrences in this part consist essentially of deposits occurring on rock benches at various elevations above the river, representing successive channels occupied by the river in cutting down to its present bed. The down-stream continuation of the pre-Glacial channel, mentioned in (2) as lying buried instream in the right bank of this part of the river, is a matter of conjecture. It is possible that the present river has followed an entirely different course from that of its pre-Glacial channel down-stream from the 20½-Mile point. On the other hand, further investigation may disclose the existence of the pre-Glacial channel in that part of the valley under consideration.

(4.) It is evident that the river flows over indurated glacial deposits at many points in that part of the valley up-stream from Pre-emption Lot 9670. These gravels are considered to be inter-Glacial from the fact that they contain seams of well-carbonized lignite where exposed on the left bank of the river somewhat above the mouth of Boyd Creek. Pre-Glacial channel-segments are indicated as lying buried instream in the left bank of 10-Mile Canyon and in the right bank in the vicinity of the 12-Mile and 13-Mile posts. The depth at which bed-rock lies is quite unknown.

The placer deposits along the Cottonwood River were worked by the early miners, and still engage the activities of a number of individuals and one company. Extensive old workings are situated on the right bank of the river up-stream from Deep Creek, at the head of 10-Mile Canyon, and at the lower end of this canyon. The last mentioned are the most extensive and cover an area of many acres. Less extensive old workings occur at other places along the river.

The placer deposits worked to date are of several different types:—

(1.) River-bars occur throughout in the part of the river examined. In some cases comparatively coarse gold is found on bars, probably due to a local source.

(2.) Bench deposits of gravel which are of quite widespread distribution and which were worked extensively by the early miners. A noteworthy example of this type of deposit occurs at the hairpin bend of the river on Pre-emption Lot 8594, where profitable deposits were found on each of a succession of terraces on the steep-sided peninsula. In each case the "pay" extends down to a layer of indurated glacial gravel.

(3.) Bench deposits of unusual type are exemplified on the lease held by F. Norn on Pre-emption Lot 8594, and also on the lease held by J. D. Pearson and D. E. Ruttan. The deeply-embayed remnants of the once-existent peninsula on the lease of the former, and the position of the sloughs on the inner edges of both leases, indicate that the benches originate from the formation of a hairpin bend, followed by the gradual washing-away of the steep-sided "peninsula" of indurated glacial gravels. In addition to the usual superficial concentration of gold, it is evident that in these particular cases there may exist a concentration along the original course of the river on the benches on a false bed-rock of indurated glacial material. Whether the concentration is commercial can only be ascertained by testing.

(4.) In the case of some benches it is evident that post-Glacial waters have cut down to the older indurated glacial gravels, carving more or less definite channels therein. In such cases the gravels may prove auriferous down to the false bed-rock, and the advisability of adequate testing with that idea in mind is indicated.

(5.) Deposits on rock benches. Deposits of this type occur at various elevations above and on both sides of the river at numerous places, but are most prevalent contiguous to the long canyon, which commences at about the 19½-Mile point. Rock benches indicate former channels occupied by the river in cutting down to its present position, and there may or may not be commercial concentration down to the bed-rock from the surface. Where from the topography it appears likely that the river has crossed a former channel there may be a good concentration in the bed of the stream immediately below the point of crossing. This is possibly the case at the 23½-Mile point, where there is a narrow channel on the north side and a wider one on the south side of a small island in the river. The bed-rock of the narrow channel was cleaned by wing-damming, but an attempt to work the wider channel was unfortunately frustrated by the wing-dam being carried out.

Most of the deposits contain appreciable amounts of platinum, and in one case iridium was found. In some instances a large amount of coarse magnetite and hematite is present. When such is the case good values in gold are almost invariably found. A logical explanation of the source of both metals of the platinum group and the iron minerals is afforded by the ultrabasic batholithic rocks traversed by the river. As previously mentioned, these rocks exhibit pronounced magmatic differentiation. The gold occurs chiefly in fine to coarse flakes, but at some places small nuggets have been found.

It is noteworthy that bench deposits, whether on false or true bed-rock, are in the majority of cases overlain by a practically barren deposit of sand up to several feet in thickness. The depth of this overburden in many cases is the determining factor of the commercial possibilities.

The gold present in the types of deposits so far noted originates either from glacial materials or from the reworking of glacial or older materials where the present river has intersected older channels. The irregular distribution of placer-gold deposits so formed should be borne in mind, and the advisability of adequate testing by pitting or drilling is clearly indicated before expenditure of material capital outlay. For example, in a succession of gravel terraces one may be very good, but for no apparent reason another immediately above or below may be unprofitable. On the other hand, as, for example, at the hairpin bend on Pre-emption Lot 8594, each terrace in a succession may prove profitable.

No attempt has been made to mine the pre-Glacial gravels exposed at the places mentioned. Therefore the depth to bed-rock and possible values present thereon are unknown factors. The possible occurrence of bed-rock values is at present a matter of pure inference and can be gauged only by a knowledge of the formations eroded. The formations eroded consisted largely of sedimentary and volcanic rocks, and the presence of a large amount of quartz pebbles in the pre-Glacial gravels suggests that quartz veins occurred in the eroded formations. There is no proof that such veins, if they existed, were auriferous except for the presence of gold

in the younger gravels. The presence of ultrabasic rocks, however, does suggest that bed-rock gravels may prove platiniferous. The tight and partly-cemented character of the pre-Glacial gravels exposed is a feature favourable to mining. Only " deep-lead " methods could be applied, so far as is now known, and therefore values would have to be correspondingly good to render extraction profitable. It is also to be borne in mind that rivers, as distinct from creeks, were not the agencies whereby bed-rock deposits of bonanza type were formed.

Lease of J. D. Pearson. The position of this lease, held by J. D. Pearson, of Quesnel, is shown on the accompanying map. The part on the south side of the river is reached by the trail from " Cottonwood Hill " on the Prince George–Quesnel Highway described at the commencement of this report. The part north of the river is reached by a steep foot-trail which leads from the highway-bridge to the top of the canyon-wall, and after following this for a short distance descends to the river. Comparatively low-lying terraced gravel benches extend down-stream for about 600 feet from the eastern boundary of the lease on the north side of the river. The benches are crescent-shaped, covered with heavy timber, and have a maximum width of about 375 feet. It is possible that a concentration may occur on them, but they have not been investigated in any detail.

Immediately below the highway on the south side of the river, and 200 feet above it, is a flat, sparsely timbered area several acres in extent. It is covered partly by this lease, but fully by another under application, staked by associates of the owner. While a concentration on this flat is possible, it has not been tested apparently to any extent, and its elevation above the river renders wash-water a problem. About 35 feet above the river is a timbered flat approximately 600 feet long by 150 feet wide underlain by rock, on which some testing has been done by pumping water from the river. The writer does not know what values were found.

The lease also covers a part of a large deeply-embayed flat, in part meadow, in part covered with willow and poplar growth, situated about 15 feet above the river. The remaining part of this flat is covered by D. E. Ruttan's lease. This unusual type of bench is illustrated on the accompanying map and its indicated mode of origin and potentialities are given in the preceding text of this report. This flat contains ground of potential promise, and more detailed systematic testing seems warranted to ascertain average values in place.

Big Boy. This placer claim, owned by C. Mackenzie and associates, is situated at the entrance to the canyon above the highway-bridge, within the area covered by the J. D. Pearson lease. It is reached by a branch trail from " Cottonwood Hill " on the Prince George–Quesnel Highway. It is reported that many years ago, at a time of exceptionally low water, coarse gold was found in the bed of the river near the right bank immediately opposite a small rock promontory on the left bank, around which the river bends. To divert the river at low water and obtain access to bed-rock in the spot mentioned, the owners commenced a 110-foot tunnel through the promontory. After driving the tunnel 70 feet, high water occurred, the portal was blocked with sand and gravel, and the project temporarily abandoned.

Lease of D. E. Ruttan. This lease is held by D. E. Ruttan, of Quesnel, and is reached by the same trail as the J. D. Pearson lease. The ground covered comprises part of the deeply-embayed flat 15 feet above the river, described in the lease of J. D. Pearson. The owner has done a certain amount of washing of superficial gravels at a point some hundreds of feet instream in the central part of the flat, and states that encouraging values were obtained.

Lease of J. W. Allison. This lease adjoins the Ruttan lease up-stream and is reached by the same trail. The ground comprises a number of timbered gravel benches which flank the left bank of the river to a maximum height of 175 feet. Other gravel benches flank the eastern side of the deeply-embayed low-lying bench covered by the Pearson and Ruttan leases. This lease so far as is known has not been tested in any detail.

Lease of F. Kruczek. This lease is held by F. Kruczek and associates, of Quesnel, and is reached by the trail previously described as leaving the Prince George–Quesnel Highway at " Cottonwood Hill." The river is crossed by boat to the workings. The ground comprises mainly the long, narrow, steep-sided promontory, or " peninsula," within the hairpin bend of the river at this point. The promontory is com-

posed largely of indurated glacial gravels, which rise vertically from the river on the east side and in benches on the west side to form a sharp ridge at the top. This promontory is noteworthy for the number of successively profitable benches which have been found to occur one above the other, from a few feet above water-level to an approximate height of 100 feet, and possibly above this elevation. These benches occur on the south end of the promontory and extend for a considerable distance on the west side but not so far on the east side, which rises sheer from the river. Concentration is due to the resorting action of the post-Glacial waters on successive strata of indurated material serving as false bed-rocks. Flanking the west side of the promontory are three benches at successive elevations of about 10 feet, 35 feet, and 45 feet above the river. The lowest bench is practically continuous on the west side and extends around the south point of the promontory, where its length is about 500 feet and its maximum width is about 300 feet. The middle bench is about 360 feet long by 120 feet wide and the uppermost bench is about 575 feet long by 55 feet wide.

There are three benches on the point of the promontory, at elevations of 25 feet, 60 feet, and 100 feet above the river, respectively. The approximate dimensions are 320 by 45 feet, 260 by 125 feet, and 600 by 100 feet, respectively. Several benches have been worked. The lowest has been completely worked, and it is stated that values were very good. The gravels were very coarse and there was little of the customary barren sand overburden. In the case of the middle bench, the thickness of gravels overlying the false bed-rock was 4 to 6 feet and sand overburden varied from a few inches to 5 feet. Work has been started recently on the uppermost bench, where about 3½ feet of sand overlies about 6 feet of pay-gravels.

The lease also includes a long, narrow bench on the opposite bank of the river facing the west side of the promontory. This bench, situated at from 5 to 15 feet above the river, is crescent-shaped, several hundred feet in length, and has a maximum width of about 225 feet.

Save for testing, the owner and his associates have confined their efforts mainly, but not entirely, to the promontory benches, in the working of which much initiative and energy has been displayed. Wash-water is pumped from the river by a centrifugal pump operated by a 3½-horse-power gasoline-engine. The gravels are mined by hand and the values recovered on an inclined blanket-table covered with expanded metal screen. Two pans taken of gravels only, from the top bench, indicated values of $2.20 and $2.62 per cubic yard respectively (gold valued at $35 per ounce). One sample contained a trace of platinum. Another pan taken from the lowest bench on the east side of the promontory indicated values of 52 cents per cubic yard. It is stated that a shaft sunk instream in this region yielded encouraging values. It is to be borne in mind that these samples do not represent the average value of the ground in place, and no account of the overburden is taken into consideration.

Lease of F. B. Dowling.

This lease, held by F. B. Dowling, is situated on the left bank of the river, adjoining up-stream the lease of F. Kruczek, and is reached by the same trail. The ground comprises a low-lying, crescent-shaped, terraced area, fronting the sharp bend of the river and rising to a maximum height of 25 feet above it. The length is about 1,350 feet and the maximum width is about 700 feet. Behind this terrace rise higher benches of considerable extent up to the plateau-level. Work has hitherto been confined to the low-lying area. A pump-hydraulic pit was opened up at the up-stream end, where there are favourable dump facilities. About 400 cubic yards were sluiced at this point, from which it is stated that gold to the value of $400 was recovered. Other testing carried out on this area indicates that there are more or less definite channels cut by post-Glacial waters in the underlying indurated glacial gravels.

Operations of H. McN. Fraser.

H. McN. Fraser obtained options during the year on the leases of F. Kruczek, F. B. Dowling, and J. W. Allison, staked additional leases on the north side of the river, and carried out much systematic testing. It is apparent that the total yardage contained in the low-lying benches is very considerable, and the object of the tests was to ascertain if the area constituted a commercial project for a small dredge. Testing consisted in sinking a number of shafts at various points and washing the entire product, so that the value of the ground in place might be accurately determined. The shafts sunk were 6 by 3 feet in the clear and were tightly lagged from the collar down. It is not known to the writer what average values were obtained. At the time of examination fourteen of these shafts had been sunk to depths varying from 4½ to 13½ feet. The average depth of sand overburden encountered was about 2½ feet.

Lease of F. Norn. This lease is situated on the left bank of the river immediately below the mouth of the long rock canyon and lies partly within Pre-emption Lot 8594. It is reached by the trail from the " Cottonwood Hill " on the Prince George–Quesnel Highway, previously mentioned; alternatively, a car with high clearance can be driven from Quesnel over the old Pacific Great Eastern Railway grade to within about 1½ miles of the property.

Rich superficial gravels were discovered on this ground by F. Norn in 1934 and he and his associates staked nine claims. In the same year C. W. Moore and his associates acquired an option on the claims, installed a pump operated by gasoline-engine, and carried out a certain amount of sluicing. For reasons unknown to the writer, operations were discontinued. The same ground was restaked this year as a lease by F. Norn. (Refer to Annual Report for 1935.)

The lease covers, for the most part, a deeply-embayed gravel bench, situated 25 feet above the river. The form of the bench is shown in the accompanying map. The area is mainly a large meadow devoid of timber, although the surrounding glacial banks on the south and west sides are well timbered. On the east side towards the river the ground rises in a series of benches to the plateau-level. On the east side, in the more immediate vicinity of the river, not far from the mouth of the large rock canyon mentioned, volcanic rocks either outcrop or have been uncovered at several places within an area about 450 by 150 feet. These rock-exposures are believed to be part of the right rim of a large buried channel which, surrounding features indicate, crosses the Cottonwood River at this point at right angles. Reference to this channel will be found in the opening paragraphs of this report.

It is strongly indicated that this bench, like that covered by the lease of J. D. Pearson and D. E. Ruttan, originated from a first-formed hairpin bend of the river.

On this bench two knolls of glacial gravels, one quite large, adjoining the river, and a smaller one farther instream, represent the remnants of the original promontory, around which the river once flowed. This view is further supported by the fact that the ground is swampy at the instream extremity of the bench, on the east and south sides.

At the time of examination the owner was mining by hand the upper gravels in the smaller glacial knoll, wash-water being supplied by means of a hand-pump from a pool in the swampy region. At this point shallow gravels overlie a false bed-rock of indurated glacial material. Two pan-samples taken by the writer merely corroborated the known fact that there are remarkably rich spots on this lease. It is stated that $1,000 in gold was recovered from approximately 100 cubic yards at one place in 1934. The gold is quite fine, although individual pieces up to 25 cents in value are reported. It is not suggested that the values mentioned are by any means average values in place, but this ground clearly warrants systematic testing to determine *average values in place.*

Cinema Gold Placers, Ltd. This is a private company incorporated in 1936 for the purpose of acquiring and operating four leases on the river held by F. Peterson, H. Ahlbeck, A. Anderson, and G. Swanson. Three of the leases are situated on the north side and one on the south side of the river, but operations have so far been confined to G. Swanson's lease on the north side. The property is situated between the 21-Mile and 22-Mile points, and is reached by a road, passable for motor-vehicles, about 7 miles in length from Cinema, on the Prince George–Quesnel Highway. The road is in part the old Pacific Great Eastern Railway tote-road and is in part newly constructed. It leaves the highway just south of the bridge over Ahbau Creek, ascends to the timbered, rolling plateau, which is followed for some miles, and finally descends the steep glacial banks which flank the immediate approach to the river to the company's camp on a flat.

The ground held is situated in the long canyon section of the river which extends from the 19½-Mile point for a length of about 4 miles down-stream. At most places in the canyon the rock walls rise steeply to heights up to 150 feet or more. In some places the walls are capped with irregular masses of glacial debris which rise to the plateau-level. In other places the walls rise to timbered gravel-covered benches, at various elevations above the river, behind which steep glacial banks form the valley-rim. It is clear that these rock benches represent segments of earlier channels of the river formed in the process of cutting down to its present bed. Most of these benches are probably of post-Glacial age, although cutting of some may have commenced in inter-Glacial times, and the possibility exists that some form the left

rim of a pre-Glacial channel. The operations of the company at present are focused on G. Swanson's lease.

The discovery of gold on the part now under operation was made by G. Swanson and associates in 1935, and that year a certain amount of hand-mining was carried out, although operations were greatly hampered by the absence of a gravity water-supply, and the necessity of tramming gravels to the edge of the bench, dumping them into a chute, and washing them at the river-bed.

The company this year, after constructing the road to the property, proceeded to install a plant. At the time of examination in June, the plant had been hauled to the ground but had not been erected, and it is not known to the writer what has since transpired. It is understood, however, that a Fresno rotary scraper was to be used for mining and conveying gravels to a screening and washing plant, and that gold-recovery of the minus ½-inch material was to be effected in a Trail oscillatory concentrator.

The essential feature of the G. Swanson lease, on which the present attention of the company is concentrated, is a crescent-shaped flat about 600 feet long and 300 feet wide, sparsely timbered and underlain by rock, situated at a height of between 85 and 100 feet above the river. This flat is terminated at both ends and also instream by glacial banks, which rise steeply to a height of 350 feet above the river. The discovery was made at the down-stream end of the flat. Here the flat merges in somewhat broken ground sloping down to a rock bench at 40 feet above the river. The rock underlying the flat is a thinly-bedded ferruginous argillite, much oxidized and intruded in some places by small basic dykes.

Hand-mining operations carried out over a river-frontage of about 200 feet and a width of about 75 feet disclosed a gradually-rising ragged bed-rock immediately overlain by a thickness of about 5 feet of gravels, in turn overlain by a thickness of 5 feet of glacial debris. Good "pay" was found in the gravels, which are of medium size and composed of both local and foreign rocks. Much black sand is present and also small pebbles of magnetite and hematite. The gravels contain appreciable amounts of platinum and iridium. The character of the gold is mainly coarse flake-gold. A sample of black sand weighing 175 grams was assayed and contained values as follows: Gold, 16.88 cents; platinum, 89.16 cents; iridium, 2.7 cents (gold valued at $35 per ounce, platinum at $40 per ounce, and iridium at $80 per ounce). It might be mentioned that in the case of placer deposits on this river the presence of *coarse* magnetite and hematite is almost always an indication of good gold values. The average of five pans, taken by the writer from the bed-rock gravels only, indicated values per cubic yard of $8.36 in gold and 98 cents in platinum. Such values are not by any means representative of average values of the ground in place and take no account of barren overburden.

The up-stream part of the flat is overlain with gravels that are of post-Glacial age, whereas it will be noted that at the point of discovery the gravels are overlain by *unsorted glacial debris*. Unless the capping of the latter is due to creep of glacial debris from the somewhat closely adjacent banks, which is possible, the inference is that the underlying gravels are, at any rate, of inter-Glacial age. The possibility also exists that the down-stream continuation of the buried pre-Glacial channel-segment of the river, described in an earlier part of this report, lies deeply buried instream at this point. If such is the case the rock underlying this bench must be the left rim of that channel. The amount of investigation carried out to date is quite insufficient to express any definite opinion on this point or concerning the length and depth of the buried channel. It does not by any means follow that the limits of the flat, for example, indicate the length of the buried channel-segment. There is at present nothing incompatible with the suggestion that it might extend considerably beyond these limits, lying deeply buried under the masses of glacial debris which terminate the flat. Much must remain conjectural pending further investigation. Continuance of work at the point of original discovery in the hope of finding either bed-rock or slope of rim-rock would seem logical.

About 1,500 feet down-stream from the point of discovery, mainly on the lease of F. Peterson and extending partly on that of H. Ahlbeck, occurs another flat about 1,000 feet in length by 600 feet in width underlain by rock at 150 feet above the river. This flat is well timbered and apparently overlain by post-Glacial gravels in which some indication of gold values has been found.

It might be added that Hush Lake, a small morainal lake on the plateau 690 feet above the river, might constitute a useful water-supply for this property if investigation warranted its development.

Leases of H. Bellos and Associates.

H. Bellos and associates, of Prince George, hold four leases adjoining up-stream the leases of Cinema Gold Placers, Limited, and a fifth situated immediately down-stream from the latter. Of the first four leases, two are located on the right bank of the river and two are on a small unnamed creek flowing into the river near the 21-Mile point. The property is reached by branch trails leading both up-stream and down-stream from the camp of Cinema Gold Placers, Limited.

On both sides of the creek mentioned are rock benches overlain by post-Glacial gravels on which a certain amount of testing has been carried out by utilizing water from the creek for wash-water. These benches lie at elevations of 50 and 70 feet respectively above the river on the west side of the creek and 55 feet above the river on the east side of the creek. Another flat of considerable extent flanks the creek instream from the rock benches mentioned, at a height of 100 feet above the river. Farther up-stream, to the limit of the leases, the valley-slope is steep and broken by gullies. The post-Glacial gravels on the rock bench, where exposed, are between 2 and 5 feet thick and are overlain by from 3 to 4 feet of sand. The average of two pan-samples, taken by the writer from gravels only, from rock benches on each side of the creek indicated values per cubic yard of $2.83 in gold and 10 cents in platinum (gold valued at $35 per ounce and platinum at $40 per ounce). The samples do not represent the value of the ground in place. Instream the benches are terminated by steep valley-banks of glacial debris. It is possible that a channel lies buried instream from these rock benches, but there is no present indication of the depth to bed-rock.

The remaining lease is situated on the right bank of the river, where the valley is narrow and steep at about the 22-Mile point. The chief feature of interest is a timbered bench underlain by rock, overlain by post-Glacial gravels, and situated at a height of 150 feet above the river. The bench is about 800 feet long and 140 feet wide. A small amount of superficial gravels have been mined, but no systematic testing has yet been carried out.

Lease of Magnus Sundberg.

This lease is situated on the right bank of the river up-stream from the 20-Mile point. It is reached by following a blazed course from a branch trail from Coughlin's trail to the river at about the 21-Mile point. Benches occur on this property of respective dimensions—475 by 50 feet, 800 by 105 feet, and 660 by 175 feet—at heights respectively of 15 feet, 45 feet, and 60 feet above the river. These benches are timbered and overlain by post-Glacial gravels. All are apparently underlain by rock. Very little investigation has been done, but pan-samples indicate promise.

Claim of R. J. Coughlin.

Pre-emption Lot 9670 is owned by R. J. Coughlin, who also holds a placer claim on this ground. The property is reached by a branch road which leaves the Quesnel–Barkerville Road 7½ miles from Quesnel and runs north-easterly across the plateau to the edge of the Cottonwood River Valley. From the end of the road a steep horse-trail leads to a ford at the western part of Pre-emption Lot 9670. The total distance from the main road is about 6½ or 7 miles.

Pre-emption Lot 9670 is almost entirely a partly-cleared terraced flat lying at from 5 to 25 feet above the river. Behind this flat glacial banks rise sharply to a height of 250 feet above the river, which practically bounds the east, west, and south sides of the lot. Argillites are exposed on the right bank of the river. This fact, coupled with the surrounding topography, indicates that the pre-Glacial channel of the river lies buried instream in the right bank of the river in this region, but the depth to bed-rock is quite unknown. Good values are found on several river-bars, but the owner confines his attention, mainly, to one near the eastern boundary of Pre-emption Lot 9670. Believing that the deposit on this bar originated from high water cutting into the bench at a point just above the bar, the owner conceived the novel idea of making cuts in the bench so directed as to aid the cutting action of the river at high water. He states that the results have been very satisfactory, the gold deposited on the bar having shown a material increase.

The owner states that encouraging values have been found at several points on the large bench-area constituting the major portion of this pre-emption lot. Average values can, however, only be determined by systematic testing. The river in this region flows over indurated

glacial debris which is exposed at several points, and there might possibly be a concentration on this material. A pan taken by the writer from the bar being worked by the owner indicated values per cubic yard of 96 cents in gold and 6¾ cents in platinum (gold valued at $35 per ounce and platinum at $40 per ounce).

Lease of Alex. Madison.

This lease is situated on the right bank of the Cottonwood River more immediately down-stream from the mouth of Frye Creek (or 16-Mile Creek as it is locally known). An adjoining lease on the east is under application by G. R. Baker and the exact boundaries are not known to the writer. The property may be reached either from Cinema by "Coughlin's trail," or alternatively from the Quesnel–Barkerville Road by the route above described to Pre-emption Lot 9670. From the latter a trail follows the right bank of the river to the lease.

The ground comprises a terraced gravel-bench area covered with vegetation and timber, the benches being situated at various elevations from a few feet to 90 feet above the river.

Placer occurrence exemplified in this region is that of post-Glacial deposits laid down on a false bed-rock, usually indurated glacial debris.

One bench 30 feet above the river was extensively worked by the very early miners, who brought water to the ground by a ditch-line from Frye Creek and flumed it across the river at the mouth of 10-Mile Canyon. An area covering many acres was mined, and these old workings, the date of which is unknown, are the most extensive of those observed on the river. The indicated reason for the rich concentration in this region is the fact that immediately below 10-Mile Canyon the river cuts directly across its pre-Glacial channel, which probably lies buried under this lease.

Much painstaking prospecting has been carried out by the holder of this lease in his search for ground in the region, which either escaped the notice of the early miners or was unprofitable at that time. He discovered one such region on a bench 5 feet above the river at the bend opposite the mouth of Frye Creek. At this point the usual sand overburden has been washed off by recent high water, and a depth of from 3 to 5 feet of profitable post-Glacial gravels were found to overlie a false bed-rock of kaolinized material over an area 225 by 50 feet.

Leases of J. Johnston and G. R. Baker.

Two adjoining leases held by J. Johnston and G. R. Baker cover the ground on both sides of the river in the vicinity of the lower end of 10-Mile Canyon. The property is reached by a trail 5 to 6 miles in length which leaves the Quesnel–Barkerville Road at 16-Mile Lake, 16 miles from Quesnel, and, crossing the plateau, follows Frye Creek closely to a camp situated on the left bank of the river, 90 feet above it. The plateau is somewhat broken by gullies and is generally well timbered. At most places, even in the wide parts, the ground falls away sharply from the plateau at the rims of the valley and the latter part of the trail is steep.

That part of the property lying west of the river comprises a terraced gravel-bench area, on which are extensive old workings. The benches are situated at various elevations, from a few feet up to 90 feet above the river, and are covered with timber and vegetation. This part adjoins the lease of Alex. Madison, of which the location of the eastern boundary is not exactly known to the writer. Much of the descriptive matter relating to the Madison lease applies also to that part of the property under description lying west of the river.

On the part of the property lying east of the river the banks of the river rise abruptly in the canyon, and below the latter quite steeply to a broken roughly-terraced, well-timbered area lying about 80 feet above the river. At a comparatively short distance from the river the ground again rises sharply.

The mode of placer occurrence exhibited on this property at the point at which the workings are situated, at the mouth of 10-Mile Canyon on the top of the canyon-wall, on the east side of the river, is a post-Glacial concentration on the left wall of the canyon. It is clearly indicated, however, that more immediately instream from the canyon a pre-Glacial channel-segment of the river lies deeply buried in its left bank and extends beyond this property. The total length of this buried channel-segment is about 1 mile, and the river, both at the head and at the mouth of the canyon, cuts more or less directly across its ancient channel. The down-stream continuation of the channel through this property probably lies west of the river. Somewhat below the mouth of the canyon, about 50 feet above the river on the left bank, partly-cemented gravels are exposed, which from their residual character

are quite possibly pre-Glacial. These gravels are covered by glacial debris. The depth to bed-rock in quite unknown.

The formation exposed at the lower end of the canyon is coarse-grained diorite, pegmatitic at some points, which contains local segregations of feldspar crystals up to 3 inches in length. Farther up the canyon ultrabasic phases of batholithic rock are exposed.

A thickness of about 2½ feet of gravels composed entirely of diorite pebbles immediately overlies a rock bench, composed of diorite, 85 feet above the river. The gravels are overlain by a thickness of from 10 to 12 feet of tight sand and silt and can readily be mined separately owing to the indurated character of the overburden. At the time of examination gravels with overburden were exposed over a length of 65 feet fronting the river. The method followed was to mine the gravels separate from the sand and silt overburden and shovel them into a chute to a bin at river-level, at which point they were washed in a sluice-flume. The extent of these gravels had not been ascertained at the time of examination. The gold occurs mainly as coarse flakes. Four pans taken by the writer of the gravels only, indicated values per cubic yard of $10.86 in gold and 30 cents in platinum (gold valued at $35 per ounce and platinum at $40 per ounce). These values do not represent the average values of the ground in place. It is understood that the owners are about to install a small pump operated by a gasoline-engine to facilitate washing. It might be mentioned that a small lake, situated about 1¾ miles distant and about 215 feet above this rock bench, might constitute a useful source of water, if developments should justify the expense involved. This winter the driving of a tunnel following the rock-bench gravels is contemplated. This will ascertain the point at which the rock bench pitches instream to form the right rim of the buried pre-Glacial channel. It does not, however, follow that, even if the rock should pitch sharply, values will also pitch downward. It frequently happens in such cases that values continue at approximately their former level on rock, if some suitable false bed-rock material exists at this horizon. There are other points near the canyon where the advisability of testing is indicated.

Lease of H. Conrad. This lease is situated at the head of 10-Mile Canyon and is reached by a branch trail leading from the Johnston and Baker leases. The ground includes a low-lying bench-area on the left bank of the river at the head of the canyon, at the upper end of the pre-Glacial segment of the channel which is indicated as lying buried instream from the canyon in the left bank. Close investigation at this point seems warranted not only in view of the position of the ground, but also because at some points promising pan-samples have been obtained Opposite this point gravels overlying a rock bench on the right bank of the river were extensively worked by early miners, who brought in water from Deep Creek by ditch-line for the purpose. The concentration at this point was presumably due to the river cutting across its former channel. At the time of examination the owner was working on a productive bar on the right bank of the river to acquire funds for further prospecting.

Leases of E. McMillan and Mrs. McMillan. Two leases held by E. McMillan and Mrs. McMillan cover both sides of the river down-stream from a point about opposite the mouth of Boyd Creek. The property is reached by a trail about 4 miles in length from the top of 20-Mile Hill on the Quesnel–Barkerville Road, distant 20 miles from Quesnel. From the highway the trail ascends gradually for 1 mile to the well-timbered plateau and then descends gradually for 2 miles to the rock-rim of the valley, then more sharply for the remaining distance of 1 mile to a cabin by the river in the central part of the lease.

In addition to river-bars, the property covers, in part, an extensive low-lying, well-timbered bench on the left bank of the river. At the lower end of the property the main rock-rim of the valley, which is composed of andesite, rises gradually from the river and, trending instream, rises more sharply south-easterly to leave between it and the river the large bench mentioned.

Productive bars of considerable extent are situated on both sides of the river on the lower part of the ground. The average of three pans taken by the writer from bars indicated values per cubic yard of $4.69 in gold and 7.8 cents in platinum (gold valued at $35 per ounce and platinum at $40 per ounce).

In the central part of the ground the large low-lying bench mentioned proved productive near the river, where a varying depth of sand up to 7 feet overlies a depth of 6 feet of pay-gravels resting on a false bed-rock of slum. Two pans taken by the writer from gravels only,

indicated values per cubic yard of 97 cents in gold (gold valued at $35 per ounce). Values are stated to be best on this false bed-rock.

In this region the river apparently flows over indurated deposits, believed to be of inter-Glacial age, because where exposed immediately above the large flat mentioned they contain well-carbonized seams of lignite, one of which is 10 inches in thickness. Argillites are exposed in the bank of the river at the up-stream end of the large, well-timbered flat. It is apparent that the post-Glacial waters formerly swept instream over the ground now occupied by the low-lying bench or flat, which is presumably underlain by indurated glacial deposits. If so, it is quite possible that profitable gravels may extend down to the false bed-rock formed by this indurated material, and it is suggested that testing is warranted to determine average values in place. It is to be borne in mind that there will probably be a barren sand overburden.

Wingdam Area.

Although placer deposits of post-Glacial age occur in this area, it is the buried deposits that are of major importance. The area includes the contact between the Precambrian and Mesozoic rocks. The rocks bordering this contact, between Wingdam and Spanish Mountain, are of much interest because important placer deposits, now deeply buried, have been laid down on the rocks of both ages. The two chief contributions to the present year's output were derived from operations on these border-rocks—namely, those of Consolidated Gold Alluvials of B.C., Limited, on the Precambrian rocks, and those of Bullion Placers, Limited, on the Mesozoic rocks.

Slade-Cariboo Gold Placers, Ltd.

This company was incorporated in the State of Washington, U.S.A., in 1932, with registered office at 1410 Hoge Building, Seattle. The purpose was to acquire and operate certain placer-mining leases formerly owned by W. C. Slade and associates on Mostique Creek (formerly named Mosquito Creek). Additional leases were subsequently staked and the company now holds Placer-mining Leases Nos. 2233, 2334, 2383, 2516, 2530, 2563, 2531, and 2679, covering the creek from its junction with Lightning Creek to a point about 2¾ miles up-stream, just beyond the divide between the valleys of Lightning and Sovereign Creeks.

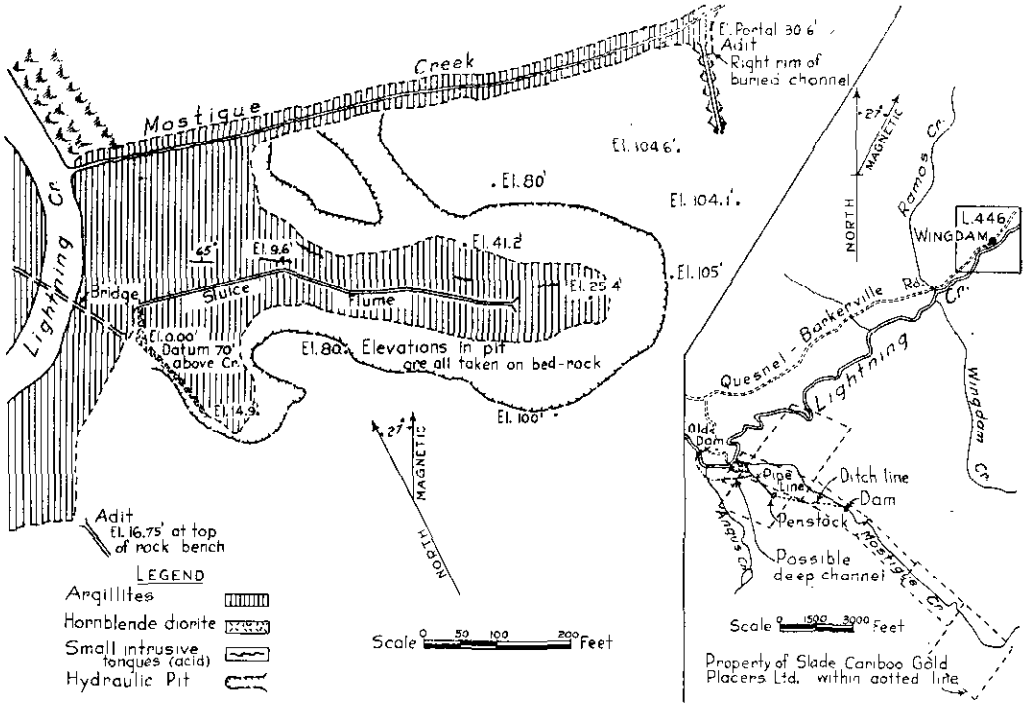
The property is situated on the south side of Lightning Creek. The camp on the north side of Lightning Creek is reached by a short branch road half a mile in length, passable for motor traffic, which leaves the Quesnel–Barkerville Road at a point about 3 miles west of Wingdam. A bridge across Lightning Creek just below the camp gives ready access to the company's hydraulic pit on the south bank of the creek.

Mostique Creek rises north of the company's property, flows south-westerly in its upper reaches, then makes a sharp turn to flow north-west after entering a succession of meadows and muskegs contained in a wide valley of mature relief, which slopes gradually in both directions at the divide between Lightning and Sovereign Creeks. From the summit of the divide Mostique Creek flows on a gentle gradient for about 1¾ miles to the point at which the company's dam is situated, the fall in this distance being determined by aneroid as 135 feet. The fall in the next three-quarters of a mile is 180 feet, and then rapidly increases in the gorge through which it flows to enter Lightning Creek at a point about 3 miles below Wingdam. The wide valley mentioned at the divide between Lightning and Sovereign Creeks is also occupied by a small unnamed creek flowing south-easterly into Sovereign Creek. Near the latter the valley narrows rapidly and the creek cascades down a rocky gorge immediately before entering its master-valley. It is therefore evident that the wide valley mentioned is a hanging-valley with respect to both Lightning and Sovereign Creeks. The region is well timbered, save where the floor of the valley is occupied by meadows and muskegs. Lightning Creek is confined in a canyon in the vicinity of Mostique and Angus Creeks. On the south side the steep rock wall rises to a height of 70 feet or more above the creek. This rock bench is overlain by a considerable thickness of glacial material, save where the latter has been resorted by post-Glacial waters, with the formation of placer deposits upon the rock bench above the canyon.

The most important type of placer deposit exemplified on this property is that of a buried channel. Topographic features and other facts clearly indicate that an earlier channel-segment of Mostique Creek lies buried in its left bank near the mouth of the creek, but the exact down-stream course of this channel, likewise the point at which it enters Lightning Creek, have not yet been clearly revealed by the work undertaken.

The property is noted for the coarse nuggets found, but fine gold is also present, originating mainly from the post-Glacial gravels overlying the deposit.

The area is underlain by Mesozoic rocks and is situated close to the contact between the Mesozoic and Precambrian. Where exposed on this property, the formation consists of argillites, which in the floor of the hydraulic pit are intruded by a tongue of hornblende diorite and small acidic tongues of batholithic rock. The strike of the argillites in the pit varies from north 23 degrees west to north 53 degrees west and the dip is north-easterly at about 65 degrees. In the vicinity of the intrusives mentioned, small irregular quartz veins up to 2½ feet in width occur in the acid intrusives and also in the argillites. Other quartz veins are exposed in Lightning Creek Canyon. The formation eroded is likely to have afforded a source for the formation of bed-rock placer deposits in Tertiary times.



Slade-Cariboo Gold Placers, Ltd. Plan showing Workings and Location of Property.
From Survey by H. Pattinson, B.C.L.S.

Gold was first found on Mostique Creek just above the gorge, and the post-Glacial deposits laid down on the bed of the creek were worked by early miners. It was evidently apparent to the latter that a buried channel lay instream in the left bank, because at that time at the upper end of the gorge an adit was driven in the left bank of the creek, which passed through the right rim of the buried channel above bed-rock. In later years a man named McPhail commenced hydraulicking at the top of the left wall of Lightning Creek Canyon about 200 feet down-stream from Mostique Creek. In 1926 the property was acquired by Caribou Mining Company, which confined its efforts to a small amount of prospecting. The following year W. C. Slade and associates became owners, and for some years thereafter W. C. Slade worked single-handed constructing a dam on Mostique Creek and bringing in a small supply of water for hydraulicking. Single-handed he continued hydraulicking, at the point where McPhail started, as long as the water-supply lasted each year, until 1932, when the ground was acquired by the present company. In 1932 the water-supply was greatly improved by construction of a storage-dam 20 feet high on Mostique Creek; a ditch-line for conveying water to the penstock; and a pipe-line from the latter to the pit under a head of about 200 feet. The size of nozzle used varies from 4 to 6 inches, depending on the water available. (Refer to Annual Reports of the Minister of Mines for the years 1926, 1930, 1931, 1932, and 1933.)

In 1933, on completion of the hydraulic installation, operations were continued at the point of commencement by earlier operators. At this point, bed-rock at the outlet of the sluice-flume is 70 feet above Lightning Creek; consequently dump facilities are very good. The pit has now been advanced for about 700 feet in a south-easterly direction. Operations have disclosed that the bed-rock gradually rises towards Mostique Creek and is somewhat higher on the north side of the pit than in the centre. There is no marked rise of bed-rock on the south side of the pit, but as the rock more immediately down-stream is somewhat higher than at the mouth of the pit, the suggestion is that a wide channel lies instream in the left bank of Mostique Creek. Gravels from 6 to 10 feet in thickness generally overlie bed-rock and are in turn overlain by much blue and yellow boulder-clay, on the top of which has been deposited 6 to 8 feet of post-Glacial gravels. The coarse gold is contained in cracks and crevices of bed-rock and in the gravels. During the entire season of 1935 the pit-face disclosed only boulder-clay resting on bed-rock and the gold-recovery was poor. At the time of examination in July of this year the face of the pit showed a total thickness of 75 feet of material overlying bed-rock. Pay-gravels from 6 to 8 feet in thickness had again appeared on bed-rock, overlain by 60 feet of boulder-clay. The management reports that subsequently the pay-gravels thickened to 10 feet, and in spite of the damage sustained by the bursting of the dam at the time of the disastrous high water in June, encouraging results were obtained. The gravels, which are locally somewhat cemented, contain many pebbles composed of rocks foreign to the vicinity. Many quartz pebbles are present, but few unduly large boulders. The pay-gravels rest on more or less comminuted and cemented pieces of bed-rock immediately overlying bed-rock.

The old adit mentioned as having been driven by early miners in the left bank of Mostique Creek is now caved, but was examined by the writer some years ago. It is 120 feet long and for the first few feet passes through rim-rock, but subsequently encounters gravels only. Bed-rock at the time of examination was not exposed, but it is stated that subsequently a small winze was sunk, which revealed rock at a shallow depth. If that is the case, this rock is approximately at the same elevation as that in the face of the pit.

Hydraulicking to date has failed to disclose any evidence incompatible with the indication that there is exposed a channel about 70 feet above Lightning Creek, the down-stream part of which has been entirely eroded were it not for certain features on adjoining property. Topographic features and workings immediately down-stream suggest, however, the possibility that somewhat deeper ground may exist immediately instream from the hydraulic pit. Moreover, general considerations incline the view that a pre-Glacial channel of Mostique Creek must have been a tributary of the pre-Glacial channel of Lightning Creek. The bed-rock of the latter is known both from the *Big Bonanza* mine-workings in this vicinity, and from others at Wingdam, to be about 165 feet below Lightning Creek. Even allowing for the fact that the pre-Glacial channel of Lightning Creek lies considerably north of the present position of this creek, the bed-rock of the company's hydraulic pit seems too high to admit of a junction on normal grade with its master-channel.

Immediately down-stream from the company's hydraulic pit the rock-rim of Lightning Creek Canyon rises to about 16 feet above the western end of the pit-floor, and continues at that level to and beyond Angus Creek. Near Lightning Creek on this rock bench were originally post-Glacial placer deposits, extensively worked by the early miners, who made persistent attempts to follow the gravels instream, only to find that in this direction the rock dipped sharply away from Lightning Creek. In recent years, W. C. Mading opened up an hydraulic pit, 325 feet long, 100 feet wide, and 40 feet deep, 575 feet down-stream from the company's pit, starting at the instream edge of the rock mentioned. The rock at this point was found to dip sharply instream. Angus Creek, about 500 feet farther down-stream, flows through a rocky gorge incised in the rock-ledge bordering Lightning Creek Canyon. Above this gorge bed-rock is not exposed on Angus Creek for about 1,000 feet. At the site of the old dam of the *Big Bonanza* mine, Lightning Creek emerges from its canyon and a draw enters the valley of this creek from the south. Immediately below this point, on the left bank of Lightning Creek, placer deposits on low-lying post-Glacial rock benches were extensively worked by the early miners. These facts suggest the possibility that the pre-Glacial channel of Mostique Creek may lie immediately instream from the company's hydraulic pit, and that its down-stream course may be more or less parallel to Lightning Creek, emerging in the valley

of the latter at the site of the old dam. The foregoing considerations merely imply that the pre-Glacial channel of Mostique Creek may be somewhat wider and deeper than originally contemplated. Much light will, however, very shortly be thrown on this matter by the continuation of present hydraulic operations. The buried channel seems likely to prove of considerable extent.

McLeod River Area.

Placer occurrence on the McLeod and McDougall Rivers consists of concentrations on river-bars, gravel benches, and low-lying rock benches. The last-mentioned type of deposit is of frequent occurrence on the McLeod River. Metals of the platinum group usually accompany the gold to some extent.

Numerous quartz veins, some large, but of lenticular character, in main sparsely mineralized, occur in the region lying immediately north of the McLeod River and east of the south-easterly-flowing part of the McDougall River. These veins occur in schistose argillites, and also as gash-veins, mainly, in metamorphic rocks. Pyroxenite and also acid types of batholithic rocks occur on the right bank of the McLeod River about 1½ miles down-stream from the mouth of McDougall River. Pyritized acidic batholithic apophyses occur close to the Fort McLeod–Philip Creek Trail, 7½ miles west of Fort McLeod. This fact, coupled with the known trend of the Cassiar-Omineca batholith, which outcrops for many miles from Mount Milligan north-west, suggests that the batholith underlies the region under description, but has not been greatly unroofed therein. The quartz veins mentioned probably originate from the batholith and are likely to follow its indicated course. As there is but little evidence of any veins being cut by the McLeod River, it seems probable that they will be found to trend north-west rather than south-east of this river. Further, it seems likely that the McDougall River marks about the western limit of their distribution. Appreciable gold values were not found in any of the veins examined, but as they are somewhat widely distributed it is possible that gold-bearing veins may occur. The presence of pyroxenite suggests the local origin of the metals of the platinum group. The gold is indicated as being of closely-local origin, although certainly derived in part from glacial materials. That on some of the rock benches, especially those on the McLeod River, may be of strictly local origin.

There is marked evidence that the ice-sheet moved south-east across this area. The glacial debris adjacent to the rivers contains a large proportion of material derived from the garnetiferous and mica-bearing rocks of Precambrian age cut by the rivers in their upper reaches, and the placer gravels contain numerous garnets.

As to the evidence of pre-Glacial channel-segments: In the right bank of the McLeod River, 1½ miles down-stream from the mouth of the McDougall River, topographic features suggest the existence of a buried segment of a former channel of the river, instream from a low-lying rock bench at this point. The pre-Glacial age of this channel is indicated by deeply-decayed rock immediately overlain by gravels containing many pebbles of pyroxenite, which outcrops at the end of the bench. It is also indicated by topographic features that an extensive pre-Glacial channel-segment of the McDougall River lies deeply buried instream in the left bank of that river below Reed Creek.

From what is known, however, of the distribution of the quartz veins, the pre-Glacial channel-segments mentioned do not seem to have eroded the most favourable terrain in the region for the formation of rich bed-rock placer deposits.

Northern Reef Gold Mines, Ltd.

This company was incorporated in 1934, with registered office at 1405 Douglas Street, Victoria. The placer leases held are numbered 690, 691, and 692, and their location is shown on the accompanying map. The property covers part of a large terraced gravel flat situated on the left bank of the river immediately below Reed Creek, where the river makes several sharp turns, forming a large bend. This flat rises gradually instream in low terraces to a maximum height of about 25 feet above the river. In places the flat is lightly timbered. It is roughly semicircular in shape, and the maximum length is about 3,000 feet and the maximum width about 1,500 feet. At the instream extremity of this flat, high, terraced, glacial banks rise sharply to the plateau-level, 200 feet above the river. Timber is chiefly second growth, save for local stands, as the region is in a burnt area. Farther instream the plateau rises gradually to about another 100 feet above the river. Prominent features of the large flat are, at the down-stream end, two rock knolls, about 40 feet high, of elliptic shape, lying parallel to one another, the larger of which

rises abruptly from the river of which it forms the left bank at this point. Rock also outcrops at the point where Trent Creek enters the flat. Immediately below the flat the river enters a steep-sided rock-walled valley.

After preliminary investigation, the company proceeded to install a hydraulic plant. The project involved bringing in a water-supply from Green Timber Lake; the construction of three dams near this lake, and about 8,500 running feet of ditch-line to a penstock situated at the top of a glacial bank 200 feet above the river; and the laying of a 24-inch main pipe-line, with two 16-inch branch lines from penstock to point of hydraulicking on the large flat previously mentioned. A sawmill of 10,000 feet board-measure daily capacity was also installed, camp buildings erected, and an Allis-Chalmers caterpillar tractor and Kirk-Hillman placer-drill hauled to the property. This installation was completed in 1935, and that year, after carrying out some drilling and hydraulicking, operations were suspended. (Refer to Annual Reports of the Minister of Mines for the years 1932 to 1935, inclusive.)

At the down-stream end of the flat as shown on the accompanying map two hydraulic pits and one long cut were opened up from the river-level. It is not known to the writer what amount of gold was recovered from these operations.

A small hydraulic pit, No. 1, follows the bed-rock of Trent Creek to near its face, where bed-rock disappears below the pit-floor. Overlying the bed-rock are post-Glacial gravels about 5 feet in depth.

No. 2 hydraulic pit, maximum width 80 feet and maximum depth at face 24 feet, exposes bed-rock in the floor. The face of this pit had sloughed considerably at the time of examination, but at the top were exposed 2 to 3 feet of sand overlying from 4 to 6 feet of gravels. Underlying the latter was a stratum of silt resting on clay and glacial debris containing many large boulders. The disposal of the latter evidently proved difficult. It is apparent from an examination of this pit that the post-Glacial waters have not at this point swept down to the underlying rock, and that values are therefore likely to be confined to gravels overlying the glacial deposit.

Somewhat down-stream from No. 2 hydraulic pit a long open-cut, 10 feet deep, was made up from the river-level apparently to test the ground between the two knolls. This cut exposed argillite at the point shown on the map. It is likely that the post-Glacial waters swept between these knolls, but from No. 2 hydraulic pit it is evident that they did not cut to any great depth.

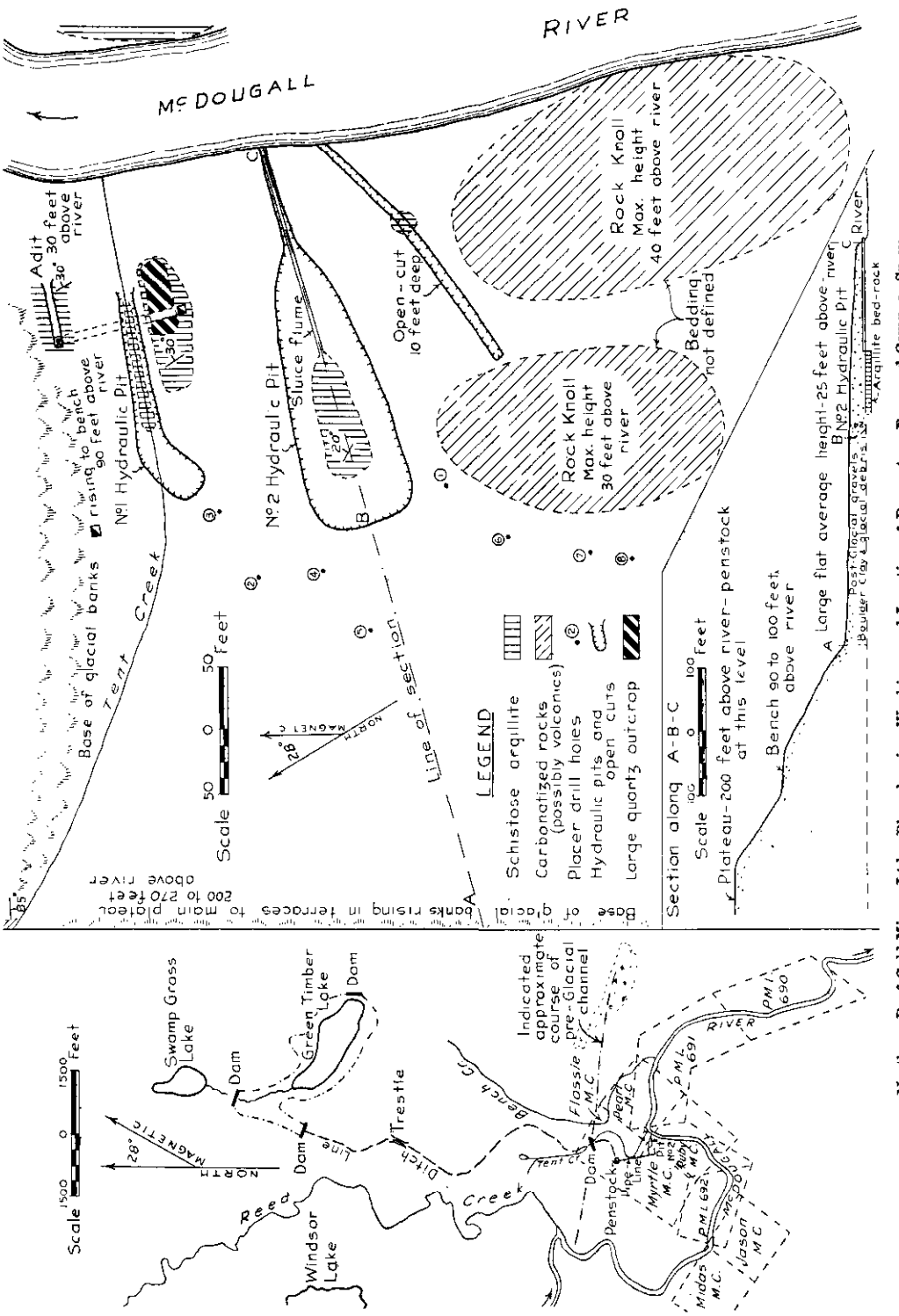
At the points shown on the accompanying map, eight holes were drilled on the flat, and four holes on a bench 90 to 100 feet above the river. The depth of these holes and values encountered are not known to the writer.

There is much in the surrounding topographic features to suggest that a pre-Glacial channel-segment of the McDougall River lies buried instream from the large flat described, under the high glacial banks. Its suggested course lies between a point on the McDougall River somewhat down-stream from the mouth of Reed Creek and the south end of Snowshoe Lake. From this point its course was probably about due east to its junction with the McLeod River. Much further detailed field-work, however, would be necessary to form an accurate opinion on this matter. Owing to deep burial, testing by means of Keystone-drilling will prove expensive, and although bed-rock values quite possibly exist, their commercial recovery involves serious consideration.

It is apparent that the obvious placer concentrations on this property are certain bars in the river, of limited extent, and post-Glacial concentrations on the large flat described. The latter type are likely to exemplify that spotty distribution of values characteristic of deposits of this type. Values will be superficial, except that if rock not now exposed underlies any part of this bench at shallow depth, concentration may extend down to it, provided post-Glacial waters have cut to that level, but not otherwise. To obtain an accurate opinion as to *average values in place* of the gravels on the large flat would necessitate detailed investigation.

Any concentration on the high glacial banks, where the latter do not overlie the pre-Glacial channel-segment mentioned, must be purely superficial, and whether such are commercial is problematical.

Apart from the pre-Glacial channel-segment mentioned, it is evident that the attitude of all obvious concentrations of placer on this property is more or less horizontal.



Northern Reef Gold Mines, Ltd. Plan showing Workings and Location of Property. Pace and Compass Survey.

Philip Creek Area.

An examination was made of Philip Creek and the Nation River in the vicinity of the mouth of the former for the purpose of determining placer potentialities.

Philip Creek, or Robinson Creek as it is locally known, rises in a series of lakes situated on the Nechako Plateau just north of the Arctic-Pacific Divide, and for the first few miles flows south-easterly, then making a sharp turn flows almost due north into the Nation River. The total length of the creek is upwards of 40 miles, but time permitted only an examination of the lower 20 miles. The width of the major part of the valley of this creek is at least a mile. This wide valley contains many lakes, and through it the large creek meanders, low-lying benches of great extent and many meadows flanking both its banks. Large masses of terraced and other glacial debris remain in the valley here and there, and extensive gravel benches have been formed, up to 100 feet above the creek, but the post-Glacial waters have to a large extent cleared the wide valley of pre-existent glacial debris down to the present level of the creek. The region is one of extremely-matured relief, and the valley-rims slope away from the creek very gradually. Rock-exposures are infrequent, save in the canyon in which the creek is confined immediately above its confluence with the Nation River. In this canyon, composed of limestone-beds, are rock benches overlain with gravels representing the successive channels occupied by the water in cutting down to its present bed. Near the creek the valley-slopes, the benches, and some parts of the floor of the valley are well timbered.

Philip Creek is reached either by pack-trail from Fort McLeod (a route which is reported as now being obstructed by fallen timber at several points) or by a pack-trail (constructed by H. M. Witter and sons) from Pre-emption Lot 9615 on "Scovil Flats" on the Parsnip River, about 25 miles below Fort McLeod. The former route offers the advantage that horses may be obtained at Fort McLeod, whereas if the alternative route is selected and pack-horses are desired, arrangements must be made in advance with H. M. Witter, who keeps the only horses available on Philip Creek. The latter route was followed by the writer. The pack-trail leaves the river, at elevation 2,070 feet, at the mouth of an unnamed creek, known locally as Scovil Creek, which flows into the Parsnip River close to the south boundary of Pre-emption Lot 9615. The left bank of Scovil Creek is followed for about 8 miles up to the forks, and thereafter the North Fork of the creek to its headwaters in a pass, at elevation 4,330 feet, in the range of mountains immediately west of the Rocky Mountain Trench. The distance to this pass from the river is about 12 miles and the difference in elevation is 2,260 feet. The trail follows through the pass, and in descending the western slope of the range an unnamed creek, known locally as Cache Creek, is followed for about 3 miles. This creek is then crossed and the gentle western slope of the range followed to a point on Philip Creek just below the junction of Wheel Creek, at elevation 2,555 feet. The grade of this trail is good, there are but few soft spots, and save in the immediate vicinity of Philip Creek and the Parsnip River timber is light. On the summit and higher parts of both slopes rock-exposures are numerous, and an excellent cross-section is afforded of the formations of which the range is composed.

Evidence of the earliest placer-mining in Philip Creek Valley is afforded by certain old workings on Wheel Creek, at which point a water-wheel, parts of which still remain, was erected thirty or forty years ago for the purpose, apparently, of supplying power for pumping in a shaft sunk on the right bank of the creek. These old workings and others on the same creek in the vicinity are not extensive. At the head of the canyon on Philip Creek, gravels overlying rock benches were worked to a considerable extent many years ago, and at other places along the canyon similar deposits were found. It is, however, quite evident that no really extensive placer deposits were found in this valley. At the present time, mining is almost entirely confined to numerous bars on the Nation River in the vicinity of the mouth of Philip Creek and at other places on the river.

Philip Creek has cut a short gorge through andesite in recent times at a point 6 miles below Wheel Creek. This gorge is west of a pre-Glacial channel-segment which lies buried instream in the right bank.

One mile above the canyon aforementioned, limestone-beds are exposed on the right bank of the creek, and the canyon, the length of which, as found by pacing, was 8,387 feet, is cut entirely in dark-coloured or black limestone-beds, argillaceous at some points. The height of the walls of the canyon varies from 10 to 150 feet. The strike of the limestone-beds varies

from north 70 degrees east to north 80 degrees west and the dip is southerly, varying from 45 to 80 degrees.

The route followed by the trail affords an excellent cross-section of the formations exposed in the higher slopes of the valley. At 740 feet above the creek schistose green-coloured quartzites are exposed, striking north 45 degrees west and dipping at from 60 to 75 degrees north-east. Intercalated apparently with these and exposed almost continuously on the higher slopes to the summit, and also over the latter on the Upper Parsnip River slopes, are gneissic diorite and less basic gneisses. On the Parsnip River slope at 625 feet above the river are extensive outcrops of coarsely-crystalline gneissic rocks composed of quartz, feldspar, and muscovite, which closely resemble a narrow belt of rocks known to outcrop at intervals for hundreds of miles immediately west of the Rocky Mountain Trench.

Very little evidence of mineralization was observed in the rocks exposed. In the bed of Philip Creek just above the canyon a quartz vein was seen, and the schistose quartzites mentioned on the higher valley-slopes contain a few quartz stringers. It is strikingly evident that in Tertiary times a remarkable amount of prolonged and largely uninterrupted erosion was accomplished by this creek. In this respect conditions were ideal for the formation of pre-Glacial bed-rock placer deposits, but there is no evidence to indicate that the terrain eroded was definitely auriferous. From what is known, this creek lies east of what may be a mineralized area. No definite evidence was found to indicate that commercial placer deposits will be found on bed-rock where its present course coincides with its pre-Glacial course, or in any buried pre-Glacial segments.

Within the part examined, the creek flows over boulder-clay, in part resorted, in its upper reaches. Boulder-clay also underlies, at shallow depth at places near the creek, post-Glacial gravels, in which fair prospects of placer may be obtained at some points. On Wheel Creek it is apparent that the placer deposits investigated by early miners overlie indurated slum or other glacial material. In the canyon, rock-bench deposits of post-Glacial age occur at various elevations above the creek, and at the head of the canyon the lower-lying benches were worked to a considerable extent in early days, and apparently proved productive.

It seems reasonable, however, to infer that the glacial debris, which is apparently the source of all occurrences of placer on this creek, was not markedly auriferous, or by this time more evidence of productive post-Glacial deposits would have been found. While, however, this creek cannot be specifically recommended for prospecting *per se*, prospectors who have occasion to traverse it for any reason might be well advised to pan the gravels overlying the widely-distributed clay false bed-rock at various points in the hope of finding some deposit which has hitherto escaped notice.

Pan-samples taken by the writer from gravels overlying clay at two points on the right bank of the creek, about 6 miles above Wheel Creek, indicated values of 25 cents and 6 cents per cubic yard respectively. A few pans were taken at a point about 6 miles below Wheel Creek from gravels overlying a rock bench 60 feet above the creek, but only a few colours were obtained (gold valued at $35 per ounce).

Wheel Creek.—This creek is of considerable size and flows north-westerly into Philip Creek. About a quarter of a mile above its mouth a tributary comes in from its north side. This tributary is incorrectly shown as Wheel Creek on maps, and the position of the main creek on which the old placer-workings exist is not shown. About 1½ miles above the mouth of Wheel Creek (main creek) are several old workings within a distance of about half a mile on the right bank of the creek, and on the left bank stands an old cabin. In this region the creek flows over either indurated slum or glacial clay, and on the false bed-rock formed by this material the auriferous post-Glacial deposits are found that were the subject of investigation by early miners. The deposits occurred as low-lying gravel benches immediately adjacent to the creek. None of the old workings are extensive. At one point a caved shaft, and the ruins of an overshot water-wheel, 10 feet in diameter, and dam and flume for supplying water for operating the wheel, seem to indicate an attempt to sink on the right bank of the creek, the purpose of the wheel being presumably to operate a Cornish pump. For unknown reasons the project was abandoned before much work was accomplished. Pan-samples taken from the creek-gravels opposite the shaft showed colours of gold. It was noted that the bed of the creek in which these old workings are situated contained glacial boulders of larger size than

at other places. No outcrops of bed-rock were observed in the part of the creek examined, but at several places indurated glacial debris is exposed.

Nation River.—This river was examined from the mouth of Philip Creek down-stream for about 4 miles to the head of a canyon. In this region low-lying gravel benches of very great extent, covered with timber, flank both banks of the river, and behind them gravel terraces rise to a height of about 100 feet above the river, the highest extending into Philip Creek Valley above the canyon.

The best and safest means of access to this part of the river is afforded by either of the routes mentioned in the opening paragraphs of this report. A horse-trail follows the right bank of Philip Creek throughout the greater part of its length to the upper end of the canyon, and at this point leads over the steep ridge between Philip Creek and Nation River Valleys.

It is possible to navigate the Nation River by motor-boat from its mouth up to Philip Creek, with various portages, but recent regrettable fatalities prove that it is a hazardous undertaking and should not be attempted even by experienced rivermen.

The placer occurrences on this river which engage the present attention of prospectors are the numerous bars which flank the very extensive low-lying benches to which reference has already been made. At the time of examination several parties well equipped with motor-boats and small pumps operated by gasoline-engines were working at different places on the river. The bars were reported to be productive by those queried.

No systematic attempt has been made to ascertain average values in the very extensive low-lying benches. Values therein are, in the absence of investigation, largely a matter of inference from topographic features studied in the light of known facts regarding placer occurrence. At the lower end of the extensive flats the river enters the first of several rock canyons. Canyons also occur on the river above Philip Creek. It seems evident that these low-lying benches overlie pre-Glacial channel-segments of the river, but the depth to bed-rock is a matter of conjecture. The region lies east of known gold-bearing areas, which presumably furnished the gold found on the river-bars. Unless, therefore, detailed local examination of the formations in this region inclines a contrary view, there seems to be no very definite reason for inferring that commercial bed-rock values are likely to underlie these benches. It is possible, of course, that post-Glacial concentrations on indurated glacial material, lying above bed-rock, may have been affected, apart from any purely superficial concentration, which will doubtless be found at some places instream on these benches. To date, prospectors have worked these benches only for a few feet instream, obviously because the outstream parts and bars are more productive. Several pan-samples were taken by the writer at one point about 3 miles below Philip Creek. Here, just instream from the river, the bench is composed of from 2½ to 4 feet of barren sand overlying about 1 foot of gravel just above water-level. Three pans taken at this point, of gravel only, indicated values of respectively 22 cents, $1.15, and 57 cents per cubic yard of gravel. Another pan taken from the same place at the instream edge of the river-bar which flanks the bench indicated values of $1.34 per cubic yard. Another taken at a point on the bench about 30 feet instream from the river indicated a value of 67 cents per cubic yard of gravel. Pans taken about 100 yards instream from this point and somewhat up-stream showed fine colours only. Another pan taken 130 yards down-stream from this point and 34 yards instream indicated values of 3 cents per cubic yard of gravel. It is to be noted that values given, except in the case of the samples from the river-bar, do not take account of the barren sand overburden, and are all based on a gold price of $35 per ounce. Owing to the great size of the gravel benches a certain amount of systematic preliminary testing seems warranted. There are also several rock benches in Philip Creek Canyon which have not apparently been investigated, doubtless because of the difficulty of getting wash-water at this elevation without pumping.

Special Reports.

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

Richfield Cariboo Gold Mines, Limited.
McLeod River Area (Lode Gold), Northern Reef Gold Mines, Limited.
Ahbau Lake Area—Moosehorn.

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

PROGRESS NOTES.

LODE OPERATIONS.

BY

CHARLES GRAHAM.

Copper River District.

Dardenelles Group.—Omineca Gold Quartz Company, Limited; Fred Wells, president. Very little has been done on this group during the year, due probably to the washing-out of the Copper River Bridge in October, 1935, and which was again damaged in the big flood of the Skeena River in May this year. The bridge has been rebuilt and the trail to the property has been completed.

Usk District.

Columario Consolidated Gold Mines, Ltd.—This property did not operate during the year.

Nicholson Creek Mining Corporation.—B. Shannon, manager. Some drifting was done during the early part of the year. Operations have been suspended for the present.

Hazelton District.

The *American Boy* mine has been acquired by new interests and it is expected that development will be commenced shortly.

Smithers District.

A small shipment of ore was made from the *Silver Pick* claims in the Babine Mountain area. Only assessment-work was done at any of the other properties.

Houston District.

Bob Creek.—Houston Gold Mines; G. W. Smith, manager. Seven men were employed for a few months during the summer doing some development-work and prospecting in the large dyke. There is a small mill on the property consisting of a crusher and table. The ore mined was put through the mill. Operations were suspended at the end of September.

There was no activity in lode-mining in any of the other districts in the Omineca Mining Division.

BY

THOMAS R. JACKSON.

Cariboo Area.

Cariboo Gold Quartz Mining Co., Ltd.—R. R. Rose, general manager; R. E. Vear, mine manager. Situated near the town of Wells. Underground work was continuous throughout the year and the mill operated, except for a period from March 23rd, when the power plant was burned down, until June 16th, when a new power plant was put into operation.

The new power-installation consists of three Rushton Diesels with a total of 1,300-horse-power at 4,000 feet elevation, which drive three Sullivan compressors that have a total of 3,000 cubic feet, free air, capacity; the above Diesels also drive the electric generators supplying electrical power and light.

The main haulage-adit, known as the 1,500 level, has reached 4,950 feet in length, and from this Nos. 1, 2, and 3 shafts have been sunk. No. 1 shaft has been sunk to the 1,700 level and is now being equipped with an electric hoist.

The levels above the 1,500 level are connected by raises to surface, which provide good natural ventilation and exits; the ventilation in long drifts being provided by fans.

During the year employees were provided with Edison electric safety-lamps.

On July 16th the mill capacity was increased from 150 tons to 200 tons per day and ran at this rate for the remainder of the year. Underground haulage is by storage-battery locomotives.

Development during the year consisted of 4,136 feet of drifting, 4,219 feet of crosscutting, 649 feet of raising, 103 feet of sinking, and 4,810 feet of diamond-drilling; 51,634 tons were mined, and this yielded 18,464 oz. of gold and 1,700 oz. of silver.

Island Mountain Mines, Ltd.—M. C. Banghart, general manager; C. Johnson, mill manager. The mine is situated close to Wells and operated continuously throughout the year with 120 men employed.

During the year a 3-compartment shaft was sunk to a depth of 528 feet from the main adit-level and levels started from this shaft. The electrical hoist installed at the new shaft is of modern design. The workings above the main level are connected to the surface by raises and this materially assists in providing natural ventilation of the workings.

Developments during the year consisted of 3,132 feet of drifting, 4,319 feet of crosscutting, 1,264 feet of raising, 528 feet of sinking, and 16,786 feet of diamond-drilling.

The tonnage mined was 43,649 tons, and this yielded 18,032 oz. of gold and 2,921 oz. of silver.

Quesnelle Quartz Mining Co., Ltd., Hixon, B.C.—Newton J. Ker, president, Russell Ross, manager. This mine is situated 6 miles east of Hixon and operated continuously from April with a crew of twelve men. The main shaft is 200 feet deep, and during the year a 2-compartment winze on a 75-degree slope was sunk from the lower level to a depth of 165 feet, and some drifting was done from it.

Natural ventilation so far has been adequate, but further developments will necessitate fan ventilation.

Development during the year consisted of 107 feet of drifting, 27 feet of raising, and 135 feet of sinking.

Some work was done during the year at the properties of Burns Mountain Gold Quartz Mines, Limited, and Cariboo Ledge Mines Company, Limited.

Likely Area.

*Mariner.**—At this property, situated on Spanish Mountain, owned by T. Bayley and F. Dickson, of Likely, a number of additional quartz veins were discovered. The veins occur mainly in alaskite, but also in schistose sediments. (Refer to Annual Report for 1933.)

*Fox.**—This group, owned by T. McGee and Alex. Dick, of Likely, is situated on the left bank of the Quesnel River, 2½ miles down-stream from Quesnel Forks.

MAGNETITE DEPOSITS.

Likely Area.

*Likely Gold Mining Syndicate.**—At the property owned by this syndicate, on the left bank of the South Fork of the Quesnel River, half a mile from Likely, surface-stripping and a short crosscut adit have exposed, in part, a lens of magnetite containing a certain amount of chalcopyrite and pyrite.

MANGANESE DEPOSITS.*

The discovery of manganese in the vicinity of the Nechako River east of Fort Fraser is reported by A. Goodwin and others, of Fort Fraser. It is understood that manganese was discovered at two different points, and that an examination was made by an officer of the Geological Survey.

TUNGSTEN DEPOSITS.

Columbia Tungstens Co., Ltd.—Donald F. Fraser, manager. This mine is situated at Hardscrabble, about 6 miles from Wells, and consists of a 70-foot 2-compartment shaft in gravel, from which there is a 350-foot drift at the end of which a winze is down and drifting is carried on from this winze.

Prospecting for sheelite has been the chief work during the year.

* By Douglas Lay.

PLACER OPERATIONS.

BY

CHARLES GRAHAM.

There has been very marked activity in placer-mining during the past year, particularly by the DeGanahl interests of New York, who are operating on Germansen, Vital, and Harrison Creeks.

About 175 men were employed in these areas during the summer, working for wages, in addition to about thirty prospectors working on other creeks not visited.

Germansen River.

Germansen Creek Ventures.—H. McN. Fraser, superintendent. This company, owned by the DeGanahl interests, has acquired twelve leases on the lower end of the creek, near its junction with the Omineca River. It was late in the season before operations were started. A camp was rushed up at Germansen Landing and considerable preparatory work done. This is a hydraulic operation, but it was proposed to do some drifting during the winter to define the rims. Thirty-eight men were employed.

Slate Creek.

Consolidated Mining and Smelting Co.—W. M. Ogilvie, manager. A large drag-line scraper plant is installed, using a 2-yard bucket. A 60-horse-power "cat" bulldozer is used to break up the ground and push the gravel into the pit through which the drag-line operates, considerably increasing the yardage that the scraper can handle. Thirty-five men are employed and camp conditions are good. A radio set at the plant provides communications with Fort St. James, Anyox, and Trail.

Manson Creek.

Only individual miners were operating on Manson Creek.

Takla Lake District—Vital Creek.

Northern Ventures, Ltd.—J. J. Warren, manager. This property, originally worked as an underground operation by Chinese, was operated in 1934 by Juneau, Alaska, interests and in 1935 was acquired by the DeGanahl interests.

A second shaft was necessary if underground operations were to be continued, so the new owners decided to abandon underground mining and use hydraulic methods. Starting late in June, 1935, preparations were begun for hydraulic operations and considerable money was spent in ditches, flumes, and sluice-boxes for tailings-disposal. Hydraulic operations started in the late spring of 1936, but were abandoned during the summer as dumping facilities were insufficient to handle the great thickness of overburden. The equipment was moved to Harrison Creek, where the conditions for hydraulic operation are much more favourable.

A shaft was started to reach bed-rock just ahead of the old tunnel, which will serve for drainage and ventilation, but the outlet has been so damaged by hydraulicking that it will not be suitable or safe as a second exit. A steam-boiler and hoist have been installed.

Harrison Creek.

Harrison Creek.—This property, operated by Harrison Creek Ventures (E. Gibbons, manager), has also been acquired by the DeGanahl interests. During the summer preparations have been made for commencing hydraulic operations, and a fine camp has been constructed. A base camp has been erected at Takla Lake and considerable work done on road-construction from the lake to Harrison and Vital Creeks.

Prospecting is being carried on at Tom Creek, Quartz Creek, and other small creeks in the area.

BY

THOMAS R. JACKSON.

Wingdam Area.

Consolidated Gold Alluvials of B.C., Ltd.—This company operates at Wingdam, with D. Campbell-Mackenzie as general manager; Leroy S. Cokely, assistant manager; John Knowles,

mine manager. The workings are known as the Sanderson, Melvin, and No. 1 shafts respectively; the No. 1 shaft was inactive during the year.

The Sanderson shaft and workings are in gravel and require careful and close timbering. The system of work is by the pillar-and-stall method, and during the year 47,777 cubic yards of ground was taken out; this yielding $210,482 in gold.

Ventilation is provided by a 6,000-cubic-foot-capacity fan. During the year a second exit was made by means of a slope driven 498 feet to the surface. Haulage is by means of a storage-battery locomotive and the workings throughout are provided with electric lights.

The Melvin shaft, sunk in rim-rock to a depth of 280 feet, or 60 feet below the bottom of the original channel of Lightning Creek, now has 1,921 feet of workings, including the main reef-drive under the old channel. Short offsets are made at 75-foot intervals from the main reef-drive, and from the offsets 4-inch diameter holes are drilled vertically up to the gravel above; these drill-holes are equipped with valves permitting control of the flow so that the drainage can be concentrated to one area and also limit the flow of water to the capacity of the pumps. When the pressure-gauges show that the water has been drained from the area above raises will be put up into the gravel and gold-recovery started. At the time of writing the first raise has been put up a distance of 62 feet and a short level driven into the gravel which had been previously dewatered.

Hydraulic Area.

*Bullion Placers, Ltd.**—The following data are kindly supplied by the management: Yardage piped during the year from *Bullion* pit, 960,000 cubic yards in 2,144 hours; a 10-inch nozzle under a head of 400 feet was employed on bed-rock and a 6-inch nozzle under a head of 100 feet on the upper gravels. Bank-blasting to promote safety was carried out, 4-inch holes being drilled to a depth of about 70 feet with an Airplane drill and blasted with 40 per cent. Polar Forcite. The extensive developments carried out included laying a new pipe-line to supply two 10-inch monitors in the South Fork pit. It is anticipated that not less than 1,250,000 cubic yards will be piped off next season. (Refer to Annual Report for 1935.)

Likely Area.

*Quesnel Mining Co., Ltd.**—This newly-incorporated private company has acquired twenty leases and one dredging lease on the North Fork of the Quesnel River, Spanish and Black Bear Creeks. A force of forty men was employed during the year in installation of hydraulic plant.

*Leases of A. L. Youngren and A. G. Youngren.**—These are situated on the right bank of the South Fork of the Quesnel River, distant half a mile from Likely. A. L. Youngren discovered coarse nuggety gold in gravels overlying rock consisting of interstratified argillite and conglomerate at 100 feet above the river.

Quesnel Area.

*B.C. Development Co., Ltd.**—This company is operating the property known as the *Tertiary* mine (described in the Annual Report for 1934). Messrs. Fraser and Peers, consulting engineers, report that a drift in the right rim of the channel was advanced up-stream a distance of 600 feet, and that a total footage of 475 feet of Keystone-drilling was accomplished.

*Horsefly Area.**

Two new discoveries, both situated close to the main road, are reported. These are:—

(*a.*) *That of A. N. Walker and Associates.*—The old "Soda Creek" shaft, sunk in the earliest days of mining to a depth of 65 feet, close to Horsefly, about 700 feet instream from the left bank of the Horsefly River, was unwatered.

(*b.*) *That of R. N. Campbell.*—The discovery of a buried river-channel is reported at a point about 1¼ miles west of Horsefly and distant about 400 yards south of the main road.

In both the above cases it is stated that a considerable amount of work was done subsequent to discovery. (Refer to Annual Report for 1931, containing a general account of the area, with map.)

* By Douglas Lay.

VICTORIA, B.C.:
Printed by CHARLES F. BANFIELD, Printer to the King's Most Excellent Majesty.
1937.

4,725-237-4740

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ILLUSTRATIONS.

The Annual Report of the Minister of Mines is now issued in parts as follows:—

Part A.—THE MINING INDUSTRY (STATISTICAL REVIEW). John F. Walker.

Part B.—NORTH-WESTERN MINERAL SURVEY DISTRICT (No. 1). Joseph T. Mandy.

Part C.—NORTH-EASTERN MINERAL SURVEY DISTRICT (No. 2). Douglas Lay.

Part D.—SOUTHERN AND CENTRAL MINERAL SURVEY DISTRICTS (NOS. 3 AND 4). M. S. Hedley.

Part E.—EASTERN MINERAL SURVEY DISTRICT (No. 5). H. Sargent.

Part F.—WESTERN MINERAL SURVEY DISTRICT (No. 6). B. T. O'Grady.

Part G.—INSPECTION OF MINES. James Dickson.

PART D

ANNUAL REPORT

OF THE

MINISTER OF MINES

OF THE PROVINCE OF

BRITISH COLUMBIA

FOR THE

YEAR ENDED 31ST DECEMBER

1936

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:
Printed by CHARLES F. BANFIELD, Printer to the King's Most Excellent Majesty.
1937.

BRITISH COLUMBIA DEPARTMENT OF MINES.

VICTORIA, B.C.

Hon. GEORGE S. PEARSON, *Minister.*

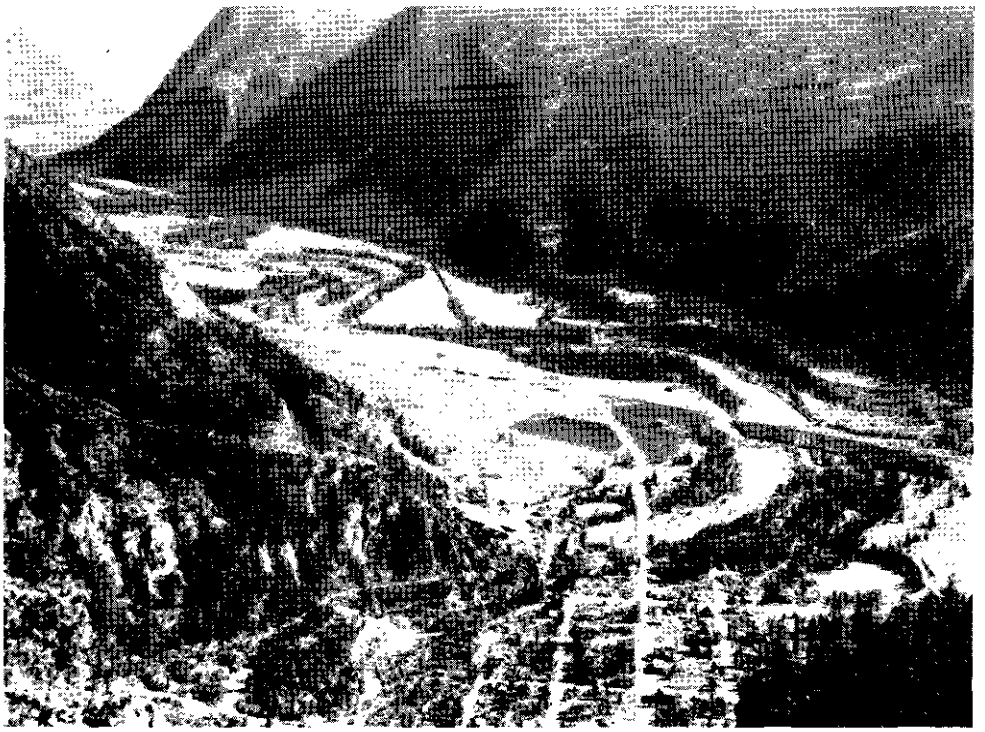
JOHN F. WALKER, *Deputy Minister and Provincial Mineralogist.*

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.*



Hedley Townsite and Similkameen River Valley.

Hedley Mascot Gold Mines, Ltd. Mill.

Nicola Mines and Metals, Ltd. Mill.

Coldstream Valley East of Vernon.

PART D.

SOUTHERN AND CENTRAL MINERAL SURVEY DISTRICTS (Nos. 3 AND 4).

BY

M. S. HEDLEY.

SUMMARY.

The year 1936 saw a satisfactory continuance of activity in mining in Nos. 3 and 4 Districts. Gold was the principal metal mined and sought for. The Hedley Camp in particular has seen expanded development and occupies a prominent position in Nos. 3 and 4 Districts in the production of gold. There was little activity in silver except in the Beaverdell area, where the principal producers operated as usual, and some exploratory work was done. Base metals were not mined except in gold and silver ores.

The projected resumption of activities by the Granby Company at Copper Mountain will be a boon to the southern interior and already, before the close of the year, work has been going forward with rehabilitations, repairs, and improvements, particularly in the shape of a new power plant.

There has been some revival in Greenwood-Phoenix area, particularly the milling of parts of the old Granby ore-bodies at the former Superior mill at Greenwood. The Fairview Amalgamated-Morning Star operated from June and the Dividend at Osoyoos had a successful year.

The Geological Survey sent three field-parties to No. 4 District. Two parties, under Dr. C. E. Cairnes and Dr. Carl Tolman, together mapped one square degree bordering the south end of Okanagan Lake and south to the International Boundary. A third party, under D. A. McNaughton, mapped in detail a considerable area in and bordering the Phoenix Camp. These maps and reports are being looked forward to with interest.

In placer-mining, hydraulic operations were stopped on Rock Creek and considerable preparatory work was done on Boundary Creek. Testing and hydraulicking was carried out on Scotch Creek. An interesting discovery was made at Harris Creek, near Vernon, in ground prospected sixty years ago.

Prospectors were active, but probably not any more so than during the two previous years.

The writer wishes to express his appreciation of the many courtesies extended him by mine operators and others during the course of his work.

LODE-GOLD DEPOSITS.

HEDLEY CAMP.

References.—Charles Camsell, Geological Survey of Canada, Memoir 2, 1910; H. S. Bostock, Geological Survey of Canada, Summary Report, 1929, Part A; Annual Reports of the Minister of Mines, 1901 to 1935, particularly 1901, 1903, 1906 to 1908, 1912, 1919, 1926, 1928, 1929, 1931, 1933 to 1935.

The name " Hedley Camp " in former years referred particularly to Nickel Plate Mountain and vicinity, but more recently has been expanded to include ground several miles distant from the town of Hedley. It is not proposed here to define the boundaries precisely, but for purposes of this report the Hedley Camp refers particularly to Nickel Plate, Lookout, and Stemwinder Mountains and to the south side of Similkameen River, short of the height of land, between Sterling and Johns Creeks.

Revival of the *Nickel Plate* and development of the *Mascot* have paved the way for a revival and expansion of activity that has been aided in no small measure by the enhanced price of gold. Development-work at the *Nickel Plate* mine by Kelowna Exploration Company has extended rather than decreased the known reserve of ore. Under the direction of Paul Billingsley, exploration has been based on the theory that the occurrence of ore is consistently related to geological structure, and as a result the company has extended favourably the

Nickel Plate zone and the Sunnyside ore-body, and has found indications of an ore-body on the *Bull Dog* claim.

On the *Mascot Fraction*, for many years idle in the midst of Nickel Plate ground, development by Hedley Mascot Gold Mines, Limited, to date has shown the ore-bodies to be larger and more valuable than indicated by preliminary diamond-drilling. More recent diamond-drilling has indicated values beneath the adit-level in previously unexplored ground. The significance of this work is not known at the time of writing, but further drilling is in progress. The company also carried out, during 1936, considerable surficial geological exploration on other parts of their holdings.

January of 1937 saw ten companies in the camp and six others with ground marginal to it. Of these, the Kelowna Exploration Company, Limited; Hedley Mascot Gold Mines, Limited; and Gold Mountain Mines, Limited, were producing, and work of various degrees of intensity was done by the others. Most of the work has been done on ground staked many years ago, but recent investigations have added to the general store of knowledge.

Briefly stated, the regional geology consists of a great thickness of banded argillaceous, calcareous, and quartzitic sediments intruded by irregular masses of igneous rocks. On Nickel Plate Mountain and on the east side of Stemwinder Mountain the sediments are predominantly calcareous, although limestone as such is subordinate. Elsewhere the rocks are more argillaceous. These rocks have, in the central part of the camp, been carefully subdivided by Camsell and further subdivided by Bostock, although the individual formations have not been traced far beyond the summit of Nickel Plate Mountain. The sediments are intruded by masses of hornblende and augite diorite in the form of stocks, dykes, and sills, the greatest concentration of which is on and between Nickel Plate and Lookout and Stemwinder Mountains. The whole is hemmed in by, except on the west, large bodies of younger granodiorite, and youngest of all are dykes of andesitic and lamprophyric character. Considerable faulting has taken place on the west side of Nickel Plate Mountain, particularly along the Bradshaw fault, which passes down the lowermost section of 20-Mile Creek and crosses the river directly opposite.

The sediments, part of the western limb of a major anticline, dip westerly to northwesterly throughout most of the area. The dip is gentle on Nickel Plate Mountain but becomes steeper to the west, and on the summit of Stemwinder Mountain the dip is nearly vertical. Locally, as on Nickel Plate and Stemwinder Mountains, the sediments are contorted. South of the river and west of Bradshaw fault the rocks are predominantly closely-folded dark argillites in which contortion and some faulting make for reversals in dip.

The mineralization on Nickel Plate Mountain has been fully described by Camsell and Bostock and is a type for the district. It consists of arsenopyrite, pyrrhotite, pyrite, chalcopyrite, and rare sphalerite, disseminated in the rock formation. The arsenopyrite contains practically all of the gold values, and while assays may be obtained from pyrrhotite, in some cases at least the values are associated with included, microscopic arsenopyrite.* This type of mineralization is not restricted to but has so far been found most intensely developed on and near Nickel Plate Mountain. Farther afield, within and beyond the Hedley Camp proper, similar mineralization has been found, of perhaps more local development.

The Nickel Plate type of ore occurs in lime-bearing rocks that are recrystallized to silicate rocks of a medium but not intense degree of metamorphism, and occurs also, locally, in diorite. The mineralization, favouring a certain type of altered sediment, tends to selectively follow the bedding, but this is not invariable and is, strictly speaking, of local occurrence only. Localization is controlled primarily by structure—i.e., fissuring of the rocks; secondly, by intensity of metamorphism, implying more particularly temperature, as marked by zones of garnetite, etc.; thirdly, by composition of the (metamorphosed) host-rocks. Consequently, in a given zone of mineralization, in which the combined factors of fissuring and temperature are favourable to deposition, mineral tends to occur selectively in certain rock-types and so may follow a particular bed or series of beds. This bedded mineralization may not, however, be continuous, depending upon the structural relation of the sediments to zones of fissuring and metamorphism.

The early fissures, those along which mineralization was in many instances introduced, are of low dip, and later ones, some at least of which are post-ore, are of steep dip. As most

* H. V. Warren and J. M. Cummings, B.C. Miner, May, 1936.

of the earlier fissures are now healed and only very rarely carry gouge, they are hard to detect; often, particularly on Stemwinder Mountain, they are closely associated with steeper systems of apparently the same age. When mineralized, the two or more sets may form together a sort of box-work of patchy mineralization, with local extensions guided by intensity of alteration, by igneous contacts, and by sedimentary structure. Flat fissures are to be found also in outlying parts of the camp, some of which contain quartz veinlets, so it does not appear as though the early fracturing along flatly-dipping planes was restricted solely to Nickel Plate Mountain, but that the basic fracture-pattern is rather widespread. In the *Nickel Plate*, however, these fractures follow more or less closely both bedding and sedimentary-diorite contacts.

Quartz veins are rare but not absent in the central part of the camp. In the darker argillaceous sediments mineralization is almost wholly restricted to quartz veins, although rare bands of silicate rock may contain disseminated sulphides. In the argillites the zones of metamorphism are of different character and extent; alteration is not so intense, and mineralization, in the form of quartz veins, occurs in frequently irregular shear-zones. Mineralization has been encountered within granodiorite on the *Mission* and *Marathon* groups of claims, and may well be early Tertiary in age. The age-relation between this mineralization and that found beyond the borders of the granodiorite batholiths is not known.

The Hedley Chief Mines, Limited, holds nineteen claims that extend across the property of Hedley Amalgamated from the gravel benches immediately west of Hedley to the summit of Stemwinder Mountain. The lower part of the ground rises steeply from the gravel benches to precipitous bluffs which are composed of well-exposed and locally contorted calcareous sediments. The upper section of the property to Stemwinder Summit is one of steep grassy slopes underlain predominantly by calcareous and argillaceous sediments, but including some diorite.

Surficial work has been done at several widely-separated points which, due to scarcity of outcrops, cannot be correlated. One open-cut, 3,500 feet south of the summit at an elevation of 3,900 feet, shows a flat, rather weak shearing in diorite carrying a little scattered arsenopyrite and pyrite. Fifty feet north-west is a cut in fine-grained banded silicate rocks, nearly vertical, cut by fine calcite stringers and with traces of mineral; between these cuts is a feldspar-porphyry dyke 15 feet wide. Above, near the central gully, elevation 4,275 feet, is a 20-foot cut on a porphyry dyke. The sediments here strike about north 15 degrees east and are vertical, and cross-fractures trend north 60 degrees west and dip 70 degrees south-west; stripping near by shows some pyrite-pyrrhotite mineralization, including traces of chalcopyrite and arsenopyrite, in green silicate rocks, some of which is related to the fissuring. Nearer the gully at the same elevation is a 25-foot adit driven east into crushed sediments.

Just below the summit of the mountain on the *Skyline* claim is an old shaft about 15 feet deep in silicified diorite, part of the same body that forms a rib on the upper part of the ridge and connects apparently with larger bodies on the 20-Mile slope; alteration, and some pyrrhotite and pyrite, is parallel to a north-westerly-trending andesite dyke 4 feet wide. On the summit of Stemwinder Mountain is a diorite porphyry that appears to be related to the younger granodiorite, a large body of which lies to the north-west.

Gold Mountain Mines, Ltd.

See Annual Reports, 1933 and 1934. This company is capitalized at 2,000,000 shares of 50 cents par value, of which 1,810,000 are outstanding. The office of the company is at 626 Pender Street West, Vancouver; G. Arnold Birks is president and J. C. Oswald is secretary-treasurer. The property, comprising fourteen claims and fractions, lies on the south side of Similkameen River, 2 miles west of Hedley. The workings are between 2,000 and 3,000 feet south of the river, at an elevation between 2,500 and 3,250 feet, on the west bank of Henri Creek. Henri Creek flows in a small narrow valley, on a bench of which the camp is situated; the ground slopes at angles of 20 to 40 degrees to the western valley-rim, which is just above the uppermost working. Timber is abundant and water is sufficient for mine and camp use. An extensive flat on the river-bank provides a site for the mill and attendant camp.

An excessively steep switchback wagon-road, 1½ miles in length, leads from the river-flat to the mine. The mill-site is reached by a road 2¼ miles in length from a bridge across the river at Sterling Creek.

Geology.—The property is underlain by a thick series of sediments that strike in general north-easterly and dip steeply to the south-east. The whole series is locally contorted, although the general attitude in the vicinity of the workings is quite uniform. These dark-coloured rocks with blocky fracture are predominantly argillites, but calcareous and, less commonly, cherty members are encountered; local bands of sedimentary breccia appear to follow the bedding. Southerly from the workings about 1,000 feet, talus-slopes and rare outcrops are of thin-bedded slaty argillite. Metamorphism is in no place extreme, and garnetite and silicate rock are not produced.

Intrusive into the sediments is an irregular body of diorite, variable in character, but similar to the diorites near Hedley. This is a stock-like mass with a westerly and a southerly prolongation, in the angle between which lies the vein system.

The mineralization occurs as quartz-filled shear-zones in the sedimentary rocks. The dip is 50 to 75 degrees westerly to north-westerly, across the bedding of the formation. These shear-zones pass into the diorite body, but in that rock are not mineralized except near the contact. A nearly flat subsidiary fracture system is mineralized with quartz stringers which are unimportant; these flat stringers in many cases roll into or are connected with steep stringers of the same age.

The quartz is as a rule watery and occurs as veins or, just as frequently, breccia-filling or a system of veinlets and lenses in rock. Mineralization includes arsenopyrite, pyrite, sphalerite, and, rarely, chalcopyrite and galena. The mode of occurrence in the quartz is very irregular, as scattered grains, lenses, or segregations, and also as seams parallel to the vein-walls. Sphalerite is not abundant and is apparently not necessarily indicative of value. Considerable of the gold is free (upon advice from Mr. Asselstine) and in an exceedingly fine state, but free gold is rarely seen in hand specimens. One exceptionally rich pocket encountered on No. 4 level consisted of massive arsenopyrite studded with free gold. There is some alteration of the walls of the shear-zone, but this is not always a prominent feature.

The property includes the old *Pollock* group, on which work was done, principally on the *Pine Knot* vein, prior to 1913. A slight amount of work was again done in 1927 and 1931 and the group was taken over in 1933 by the present company, which, after some exploratory work, bonded the property in 1935 to the Consolidated Mining and Smelting Company of Canada, Limited. This company, after doing 750 feet of diamond-drilling, relinquished the option late in 1935. Since that time Gold Mountain Mines, Limited, has further developed the property and has built a 60-ton mill that commenced operation early in January, 1937.

Four veins are known on the property; only one of which, the *Maple Leaf*, has received much attention.

The *Pine Knot* vein, which strikes north 25 to 30 degrees east and dips north-westerly at 50 to 65 degrees, is exposed by old workings which include an adit with 120 feet of drift, and by cuts, shafts, and short adits over a length of 600 feet, most of which are in sediments. On the north-east end, in diorite, the vein pinches. It varies from a foot or so to 12 feet in width, the greater width when following an andesite dyke; mineralization of the quartz is not heavy. The only work done in recent years, by the present company in 1936, is a 50-foot winze sunk from a 30-foot adit. Channel samples in a short crosscut in the bottom of this winze returned:—

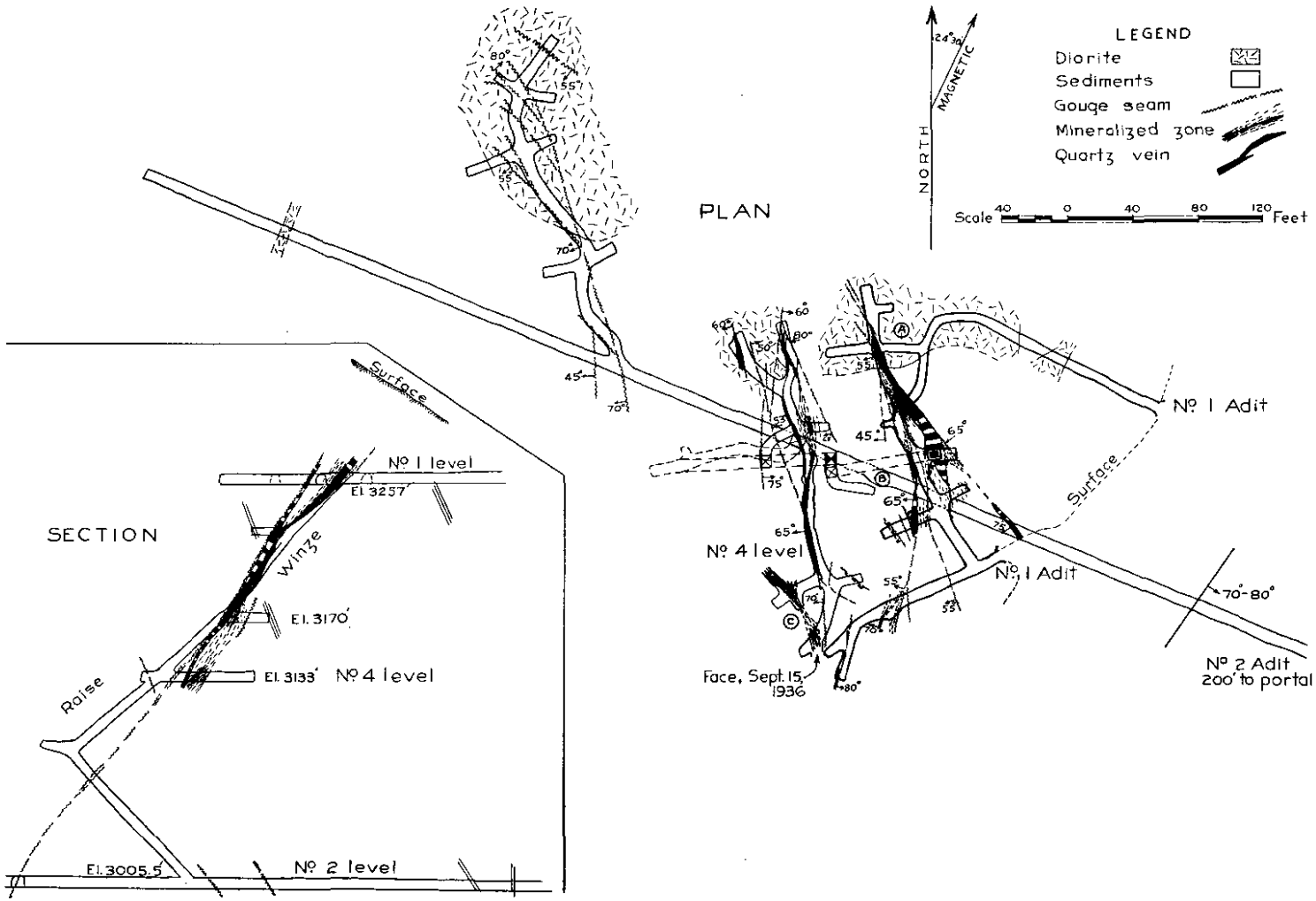
(1.) Sixty inches, horizontal, on hanging-wall of vein, quartz and bleached rock and gouge: Gold, 0.02 oz. per ton; silver, 0.2 oz. per ton.

(2.) Forty-five inches, succeeding, to horse of waste: Gold, 0.03 oz. per ton; silver, 0.2 oz. per ton.

(3.) Thirty inches, horizontal, on foot-wall below 58-inch horse of waste: Gold, trace; silver, trace.

Two small and unimportant veins lie between the *Pine Knot* and *Maple Leaf*. These occurrences are similar to the others, but widths rarely attain 1½ feet.

Maple Leaf Vein.—This is an irregular, branching shear-zone striking about north-south and dipping 60 degrees to the west. Numerous gouge-seams occur in the zone and pass into the walls. Much of the mineralization is, properly speaking, quartz-filled breccia. The accompanying map, from transit surveys by the company, shows the nature and extent of the mineralized sections of the zone better than a purely verbal description. The zone itself varies in width up to about 30 feet and strongly mineralized portions of the zone (i.e., referring



Gold Mountain Mines, Ltd. Plan and Section of Workings on Maple Leaf Vein, based on Company's Surveys.

particularly to quartz) attain single widths as great as 12 feet. In the greater part of the zone mineralization is associated with quartz only, alteration is not intense, and quartz and wall-rock are sharply distinguished. In one section of No. 4 level at (C) on the accompanying map there is strong alteration and some mineralization within the rock gangue. There appears to have been a considerable amount of replacement in this section. Exploration has been close to the contact with diorite and it is in the general vicinity of this contact that the strongest mineralization has been encountered. Mineralization is not, however, continuous on the dip of the vein in this section.

The workings include two adits. No. 1 adit, elevation 3,255 feet, explores the shear-zone over a length of some 200 feet, but does not give a continuous section for that distance. From this adit-level a winze is sunk 110 feet on the most promising section. No. 2 adit, elevation 2,999 feet, 970 feet in length, passes through the barren shear-zone which is explored by drift across the diorite-contact for 200 feet. A raise later was driven to connect with the bottom of the winze from No. 1, and a sub-level, known as No. 4 level, elevation 3,133 feet, was 205 feet long at September 15th, 1936. Since that date, besides further drifting south on No. 4 level, another sub-level, some 40 feet lower, was driven to tap the shear-zone; at a still later date a crosscut is reported to have encountered mineralization on No. 2 level some 100 feet south of the original crosscut.

Several short diamond-drill holes were put down by the company at an early stage of development from a station at (A). Four holes were drilled from (B) by the Consolidated Mining and Smelting Company to cut the shear-zone south of the crosscut, both level with and above No. 2 level; a fourth hole was drilled on line from the face of the crosscut. The results of all of this drilling are not known. The shear-zone is now, on No. 4 level, explored farther south and higher than where cut by the southernmost drill-hole from the drill-station at (B).

Distribution of quartz in the various parts of the shear-zone is irregular and gold values are erratic. Channel samples taken by the writer illustrate this latter fact:—

(1.) Bottom of winze, south side, 42 inches horizontal on hanging-wall of zone: Gold, 0.82 oz. per ton; silver, 0.4 oz. per ton.

(2.) Succeeding 50 inches horizontal: Gold, 0.09 oz. per ton; silver, 0.6 oz. per ton.

(3.) Succeeding 85 inches horizontal: Gold, 0.05 oz. per ton; silver, 0.2 oz. per ton.

(4.) Succeeding 16 inches horizontal on extreme foot-wall: Gold, 0.015 oz. per ton; silver, 0.2 oz. per ton.

(5.) Seam of heavy sulphides, 1½ to 3 inches wide, in hanging-wall section: Gold, 4.84 oz. per ton; silver, 1.6 oz. per ton.

(6.) No. 4 level, where zone was first encountered, 48 inches cut normal to a flatly-dipping strand of quartz 6 feet from hanging-wall: Gold, 0.005 oz. per ton; silver, 0.2 oz. per ton.

(7.) Same location, 52 inches horizontal on hanging-wall section of zone: Gold, 0.03 oz. per ton; silver, 0.2 oz. per ton.

(8.) No. 4 level, 40 feet south of last point, 22 inches: Gold, 0.80 oz. per ton; silver, 0.5 oz. per ton.

(9.) Fifteen feet south of (8), 34 inches: Gold, 0.30 oz. per ton; silver, 2.3 oz. per ton.

(10.) No. 4 level, face of small drift north of (C), 60 inches: Gold, 0.02 oz. per ton; silver, 0.1 oz. per ton; zinc, 0.7 per cent.

It is not a simple task to determine average values over more than limited sections of the shear-zone. Very careful, close-interval sampling would be necessary to obtain general figures, and development has not exposed the zone sufficiently to make this possible. Occasional very high assays are reported, and proper weighting of these in averages is a problem. Physical difficulties in mining branching ore-bodies in sheared ground cannot at the present time be assessed, but it is safe to say that mining will not always be easy. The writer consequently is not able to state any definite figures regarding tonnage of proven commercial ore.

No. 4 level is, at the north end, near the bottom of mineralization in this section of the mine. Mineralization on this level is not quite as strong as on No. 1 level, and, except for a central, rather narrow, vein-line section 120 feet long, is very irregular. Development here is at a somewhat critical stage, because continuation of minable ore southward and downward from the south end of No. 4 level is important.

It is not known whether the shear-zone continues to the south. Mr. Dollemore at one time did some ground-sluicing about 1,000 feet south of No. 1 adit, which disclosed some heavy

quartz, apparently nearly in place, and roughly on the line of strike of the *Maple Leaf* vein. Further work here would be justified, in spite of the difficulty of working on an excessively steep side-hill, at least to the point of proving the origin of this quartz. Further drifting southward on No. 1 level is not feasible because of the nearness to grass-roots, and it is evident that exploratory work is best carried out on No. 2 level.

A crew of some thirty men is employed at the mine under the superintendence of Frank Dollemore. Late in the year a concentration plant near the river was designed by and built under the direction of W. J. Asselstine, a tram-line was installed, and power was brought in by a short branch line from that of the West Kootenay Power and Light Company. At the mine a 580-cubic-foot Holman compressor is driven by a 100-horse-power 2,200-volt motor. A 2-bucket jig-back gravity-tram with 1,000-lb. buckets has a cable distance of 2,900 feet between terminals over a vertical rise of 1,200 feet. Ore from an 85-ton coarse-ore bin is crushed to ¾ inch by jaw-crusher and is elevated to a 200-ton fine-ore bin, and from there it goes to a 6-foot by 36-inch Hardinge ball-mill with screen. Undersize is fed to a Denver unit cell and oversize and unit-cell tailings go to a Hardinge classifier, the overflow from which goes to a 5-foot Denver conditioner. Flotation is in six Denver cells, concentrates from which go to a 12-foot Denver thickener and 3-foot Oliver filter; flotation tails flow over blanket-tables. Concentrates are sacked and hauled by truck to Hedley, whence they are shipped by rail to Tacoma. The mill is operating at about 65 tons per twenty-four hours.

Hedley Gold Hill Mining Co., Ltd.

This company is capitalized at 2,000,000 shares, of which 950,000 are outstanding. John W. Gallagher, of Hedley, is president of the company and McAlpine and Elliott, of Vancouver, are the fiscal agents. The property consists of eight claims, the *Gold Hill Nos. 1* to *8*, situated on the south side of Similkameen River, 1¾ miles from the river and 3½ miles south-west of the town of Hedley. Access is by pack-trail 2½ miles in length from Sterling Creek over lightly-wooded, grass-covered slopes; another, steep trail 1½ miles in length, leads from the camp of Gold Mountain Mines, Limited, whose property adjoins on the north. The showings are on the summit of a low rounded hill at an elevation of about 4,700 feet in an open grass-covered country with few outcrops. The hillsides are not steep, but small bluffy slopes create an irregular, hilly topography. A tent-camp is located in a small draw below the workings and water is obtained from a spring.

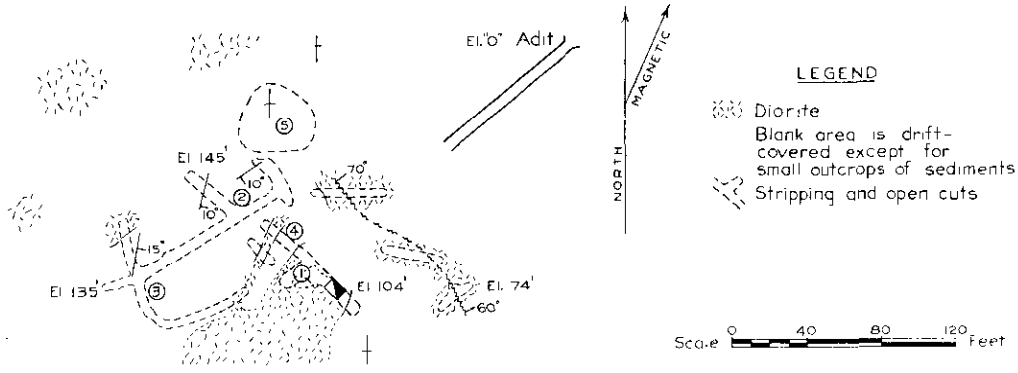
The most abundant rocks are members of a thick sedimentary series comprising chiefly argillites and rare calcareous beds. The strike in general is north-south and the dip vertical, but there is marked local contortion. Intrusive into the sediments is a medium to fine-grained diorite that forms irregular bodies several tens to hundreds of feet in extent. The accompanying sketch-map does not clearly show relationship of diorite and sediments, but it appears that there is one body of diorite to the south of the principal cuts and one body, with a northerly extension, on the north-west. Three hundred and fifty feet north-west of the principal showings are three cuts in sediments, some 60 feet north of which is more diorite.

The impression is at first gathered that this is an area of sedimentary remnants existing as the roof of a large intrusive mass. The writer does not, however, believe that this is so. The region as a whole contains many dykes and stock-like bodies as well as some flat sheets of diorite, and it is his opinion that here, in an area of structural disturbance, there is a complex of interconnecting intrusive bodies rather than one large mass.

Workings.—A number of shallow cuts and strippings have been made, some in diorite and some in sediments. A cut (1) from which a 12-foot shaft has been sunk discloses a large mass of practically solid calcite which forms a rhombic outline about 20 feet on a side and, except for the north-west corner, is entirely in diorite; the margins of this mass are not perfectly regular and the extension in depth is not known. The calcite carries practically no sulphides where exposed in the open-cut, but in a small chamber at the bottom of the shaft there are lumps of pyrite and pyrrhotite up to fist size or larger. There is some shearing of the wall-rocks, and a strong sericitization which produces white clayey granular material in which the original dioritic texture can just be recognized. This complex of sericite, kaolin, feldspar, and quartz contains no calcite. There is little evidence of mineralization in the diorite except at the contact with massive calcite, although some sheared diorite is now oxidized to a reddish to yellowish earthy material. The occurrence of this large rhomb of calcite is abnormal, and it is not known whether it is a cavity-filling or a replacement.

North-west of the shaft in a long cut, at (2) and (3), argillites and some calcareous rocks have been brecciated and filled with calcite. The sediments which elsewhere dip vertically are here flexed into an east-west fold that plunges westerly, the southern limb of which is nearly flat. In this flat section calcite fills between the bedding-planes and also in transverse breaks to form a coarse-textured, calcite-filled breccia. Mineralization is erratic and consists of pyrite in small seams and lumps to fist size, small amounts of pyrrhotite, and traces of arsenopyrite, chalcopyrite, sphalerite, and galena. At (4) there is smilar breccia with less calcite. South of (3) the mineralization, together with calcite-filling, decreases and in the cuts north of (3) and (2) it also becomes less. At (4) there are fine, vuggy quartz stringers which contain some fine chalcopyrite, galena, pyrite, and arsenopyrite. At (5) a bench has been stripped that shows the flexure of north-south sediments into an east-west anticlinal axis; there is a little pyrite here. In the three small cuts to the east, on the flank of the hill, there is exposed a shear-zone in diorite. This zone is a foot or so wide in partly altered diorite and contains a little pyrite. In the cuts aforementioned, 350 feet to the north-west, there is a little mineralization in sediments, chiefly as rusty streaks.

An adit 100 feet below the small shaft has been driven from a draw at the base of the hill through dense, grey calcareous rocks which contain thin bands of diorite and are speckled with a little pyrite and occasional very fine pyrrhotite, particularly along thin seams of alteration. This adit was 85 feet long at the time of the writer's visit. It was later extended to a point immediately below the open-cut at (1). It is reported that no diorite was encountered,



Hedley Gold Hill Mining Co., Ltd. Sketch-plan of Principal Workings.

but that there is some contortion in the sediments and some mineralization similar to that on the surface. It appears from this that the diorite is not steeply dipping and must extend downwards to the west.

Four samples returned the following: No. 1, selected sample from (3), taken to include as much arsenopyrite as possible (about 20 per cent. pyrite with small amounts of pyrrhotite, arsenopyrite, chalcopyrite, sphalerite): Gold, 0.04 oz. per ton; silver, 0.2 oz. per ton. No. 2, taken from shaft, selected sample of heavy red oxidized material in diorite: Gold, 0.19 oz. per ton; silver, 0.8 oz. per ton. No. 3, selected sample from shaft of pyrrhotite and pyrite, taken to favour pyrrhotite, from within and at the margin of heavy calcite: Gold, 0.035 oz. per ton. No. 4, from same locality, selected sample of practically pure pyrite taken from solid calcite: Gold, 0.08 oz. per ton.

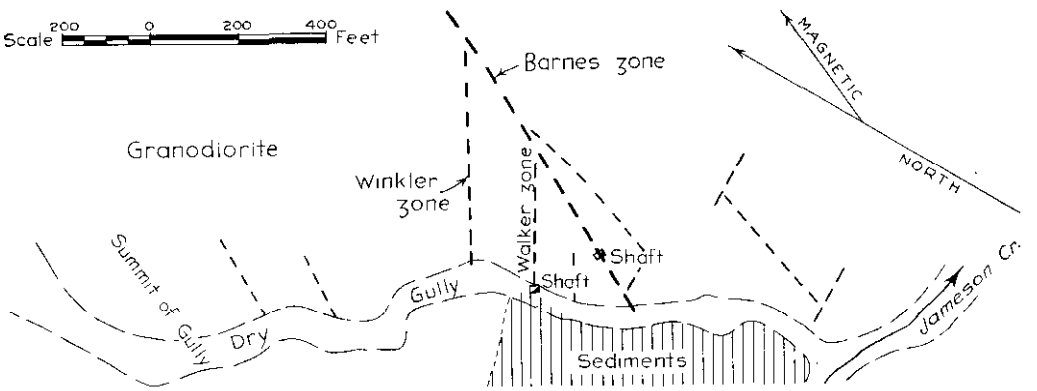
Occasional samples have been reported from this ground that carry higher values than those taken by the writer. These have all been, however, selected samples. Total percentage of sulphides is not great and the calcite does not appear particularly favourable. It is noticed that when there is a slight amount of quartz the mineralization is more diversified and more promising than when in calcite alone. This leads one to believe that should any quantity of quartz be found mineralization would prove more interesting.

Half-way between the workings and Gold Mountain mine, an east-west fold is observed in thin-bedded argillites, and it seems likely that this is the same line of crumpling as that at Gold Hill. Although it may be that the presence of diorite is a necessary factor to mineralization, this structural axis might be worth prospecting.

Mission. This group of six claims is owned by H. D. Barnes, of Hedley; James Walker, of Vancouver; and George Winkler, of Victoria. It is on the south side of Similkameen River, 2¾ miles south-west of Hedley in a straight line. The showings are at elevations of between 4,300 and 4,500 feet on the west side of Jameson Creek, the first stream flowing into the river below Hedley. This is a hilly region a short distance back from the edge of Similkameen Valley; the hillsides are steep but not precipitous and timber cover varies considerably in thickness. The showings are on an open, grass-covered slope, separated from rather thick woods on the south-west by an irregular, dry gully.

A foot-bridge crosses the river and a pack-trail climbs rapidly up the steep, bluff-covered valley-wall to an elevation of about 3,000 feet; the trail then leads up the wooded valley of Jameson Creek, in which there are few outcrops. No permanent camp is maintained.

The showings are in a westerly-projecting tongue of the large body of granodiorite that outcrops both north and south of the river in this locality. The rock here is a biotite granodiorite, brownish-grey in colour, and of medium grain. Surrounding the diorite and rarely as inclusions of roof-pendants are sedimentary rocks, predominantly argillaceous in character. One such mass lies immediately south-west of the principal showings. One or two andesite dykes are intrusive into the granodiorite and appear to be older than the mineralization; the geological age of these dykes is not known, but they may be Tertiary. Mineralization, entirely within the granodiorite, has been disclosed in several shear-zones near an irregular, dry gully



Mission Group. Sketch-plan of Shear-zones in Granodiorite.

(*see* sketch-map). There are few outcrops, and the finding and tracing of most of these zones has been the result of careful and expert prospecting. There are three principal shear-zones, known as the *Barnes*, *Walker*, and *Winkler* zones, on the first two of which small shafts have been sunk; other zones have not been named. None of the numerous open-cuts are shown on the accompanying sketch-map.

There is a strong alteration of the granodiorite in the shear-zones to a whitish granular material in which the original texture can barely be recognized; this is composed of quartz, white mica, a little chlorite, and traces of epidote and calcite. Sulphides occur in this material as bands and masses, sometimes accompanied by dull white quartz, but the latter is never abundant. The distribution and percentage of sulphides is hard to determine, due to a strong oxidation which may, near the surface, obliterate all traces of metallic sulphides. These include pyrite, fine-grained arsenopyrite, dark-brown sphalerite, and a very little tetrahedrite and chalcopyrite, all in varying proportions and amounting, in total, from a trace to 40 per cent. of a zone several feet wide. The strongest mineralization is in the *Barnes* zone, on which a 12-foot shaft has been sunk and which has been exposed by open-cuts at close intervals for 250 feet, disclosing promising mineralization; the indicated length of the zone is about 800 feet. The zone is 10 to 15 feet wide and locally 2 or 3 feet wider, although the actual limits are not readily determined. The *Walker* zone has been trenched at frequent intervals from a 20-foot shaft to its junction with the *Barnes* zone, a distance of some 300 feet. Sediments show on the west side of the shaft, and fairly strong mineralization is evident in the shaft and several of the trenches. The *Winkler* zone, discovered in 1936, has not been more than

surficially explored; less mineralization is evident, although oxidation has been sufficiently heavy to obliterate much of the sulphides. Other shear-zones are geologically similar, but are weaker structures than the three principal zones. All stop at the dry gully, which must mark the presence of a fault or series of faults.

Sampling has failed to return values as good as might be expected from a study of the mineralization. Those taken by the writer follow:—

(1.) Selected from bottom of *Walker* shaft, quartz with 20 per cent. arsenopyrite and a little pyrite: Gold, 0.08 oz. per ton; silver, 0.2 oz. per ton; copper, *nil.*

(2.) Chip sample from bottom of *Barnes* shaft on south-east side in mineralized altered diorite containing pyrite, some heavy arsenopyrite, and a little sphalerite: Gold, 0.04 oz. per ton; silver, 3.5 oz. per ton.

(3.) Selected from *Barnes* shaft-dump, heavy arsenopyrite with less pyrite and sphalerite: Gold, 0.06 oz. per ton; silver, 8 oz. per ton.

(4.) The same, picked to favour sphalerite: Gold, 0.20 oz. per ton; silver, 20 oz. per ton; zinc, 10.8 per cent.

Victoria.

This group of seven claims consists of one Crown-granted claim, the *Victoria*, held on lease, and six located claims. It is owned by T. C. McAlpine, of Summerland, and associates. The claims are on the south-east side of 16-Mile Creek, 4 miles below Hedley. They are 1½ miles from the highway and the principal showings are 1,500 feet from the creek at an elevation of about 3,550 feet. The lower part of the hillside consists of timbered talus-slopes and at and above the workings bluffs are prominent. A steep trail in overburden and slide material leads up the narrow creek-valley, from which an old trail is followed with difficulty up to the workings.

The rocks are predominantly argillites; near the creek dark carbonaceous argillite predominates, and at the workings the rocks are more hard and blocky and include fine-grained quartzitic members. The structure is not known. The sediments are cut by andesite dykes, and by diorite near by. The mineralization consists of a single quartz vein which strikes south 30 to 40 degrees east and dips steeply south-west. The vein, free-walled in shattered ground, consists of vitreous crystalline quartz bearing arsenopyrite, pyrite, pyrrhotite, and chalcopyrite and occasional seams and patches of chloritic material.

Workings consist of three adits as well as a few exploratory open-cuts, now caved. The lowest adit, elevation 3,325 feet, is driven south 50 degrees east for 50 feet in rock. No. 2 adit, elevation 3,550 feet, is 190 feet long at an average bearing of south 30 degrees east. The vein, 1 to 4 inches wide at the portal, splits and becomes lost in the right wall at 40 feet. At 80 feet the vein, still narrow, is picked up beyond a steep cross-fault and is joined by the split from the right wall at 110 feet; thence for 35 feet it averages 2 feet in width, when it is stepped 15 feet to the east by a steep cross-shear. In the inner 35 feet the vein averages 20 inches wide. No. 1 adit is 215 feet distant, at a bearing of south 41 degrees east from No. 2, and is 155 feet higher; it is 72 feet long, bearing south 40 degrees east. The vein varies between 18 and 26 inches wide and averages about 23 inches.

The distribution of sulphides in the quartz is irregular. In No. 1 adit heavy seams and lenses of arsenopyrite form locally 25 to 50 per cent. of the vein-matter; in No. 2 adit sulphides form a low percentage. A chip sample of the face of No. 2 adit, quartz 26 inches wide, returned: Gold, 0.28 oz. per ton; silver, 0.3 oz. per ton. A selected sample of heavy arsenopyrite returned: Gold, 0.13 oz. per ton; silver, 0.25 oz. per ton.

Toronto.

This group of eight claims is owned by T. C. McAlpine, of Summerland, and associates. It is 3,000 feet south-west of the fork of 20-Mile Creek between elevations of about 3,000 and 4,000 feet. The region is precipitous and the principal showing is at the base of prominent high bluffs. The easiest approach is from the fork of 20-Mile Creek by angling back up the valley-side.

The rocks are prominently-banded calcareous to argillaceous and cherty sediments intruded by a complex of dioritic dykes. A body of coarse-grained granite of unknown extent occurs a quarter of a mile south-west of the fork. Two veins of white quartz from 1 to 5 feet wide occur in the granite; the strike is north 80 degrees east and dip 75 degrees south. A little surface work, including a 12-foot shaft, was done on these veins many years ago, but assays are reported to be low.

At the base of the eastern side of the bluff, elevation 3,350 feet, a 10-foot adit is driven on a 5½- to 6-foot mineralized zone in sediments. The zone contains strands of watery quartz, associated with and between which are bands and streaks of pyrite and small amounts of chalcopyrite and galena. Variations in width of the zone and of individual members are frequent; the quartz in the vicinity of the adit attains a maximum width of 15 inches as a foot-wall strand. The strike of the zone is north 80 degrees east and the dip 75 degrees north. A sample in the adit of the foot-wall mineralized quartz, 11 inches wide, returned: Gold, 0.02 oz. per ton; silver, 4.8 oz. per ton.

Apex Mountain Area.

Nelson.

This group of four located claims is owned by T. C. McAlpine, of Summerland, and associates. It is situated just south-west of the peak of Apex Mountain at an elevation of about 6,750 feet and adjoins the *Independence* and other Crown-granted claims. The group is at timber-line on a grassy rolling hillside with an average slope of about 15 degrees, and on which outcrops are few. Timber is plentiful at the lower edge of the claims and water may be obtained from a small stream.

The claims can be reached by car from the main Nickel Plate Road by an old road which leads to a summit of 7,140 feet elevation, a distance of about 2½ miles. From the summit it is just possible to take a car down grass-covered slopes for an additional mile, practically to the principal showing.

The rocks are altered sediments—silicate rocks, argillite, quartzite, chert, limestone. Intrusive into these is diorite, the extent and distribution of which is not known, due to scarcity of outcroppings. There are in this area impregnation deposits, chiefly of pyrrhotite, in rock, but on this group the important showing is a quartz vein in silicate rocks close to a contact with diorite. The quartz is white and crystalline and contains vuggy seams and lenses with crystals up to 2 inches in length. Massive granular arsenopyrite is the principal sulphide; pyrite is associated with the arsenopyrite, particularly where there is vuggy quartz; the more pure pyrite is in porous crystalline masses. The vein strikes north 70 degrees east and dips 80 degrees north.

There is one open-cut 38 feet long on the vein, the face of which is 10 feet high; a little underhand stoping, now water-filled, has been done near the face. The vein is reported to be a maximum of 3 feet wide, although all that can now be seen is a split section in the face consisting of a 2- to 6-inch hanging-wall strand and 12- to 17-inch foot-wall strand. A small shaft, now caved, with a little quartz on the dump, is westerly 135 feet from the cut. Easterly for 140 feet from the open-cut, stripping, in diorite, has failed to disclose the vein, although there is some evidence of a vertical fissure and of a little quartzose material. Beyond these points there are no outcrops; it is probable that the diorite extends several hundred feet east on the strike of the vein.

There are two piles of ore; one, of about 7½ tons, contains 50 per cent. sulphide, and the other, of about 30 tons, is more sparsely mineralized. Three samples returned: (1.) Selected sample from dump of solid arsenopyrite with 15 per cent. quartz: Gold, 0.64 oz. per ton; silver, 1.6 oz. per ton. (2.) Selected sample of arsenopyrite and pyrite with 30 per cent. quartz: Gold, 0.44 oz. per ton; silver, 1.2 oz. per ton. (3.) Grab sample of larger dump: Gold, 0.10 oz. per ton.

Keremeos Creek Area.

Gold Valley Mines, Ltd.

This public company was formed in June, 1936, to take over the undertakings of Gold Valley Mines, Limited, a private company. The head office of the company is 417 Vancouver Block, Vancouver; A. K. Shives is president and A. C. McDougall is managing director and secretary, and G. H. Shephard is consulting engineer. The property comprises nineteen claims and fractions, of which five are Crown-granted. It is situated on the west side of Keremeos Creek just below Olalla and 3 to 4 miles north of Keremeos.

The southern part of the property is on a steep, slide- and bluff-covered hillside that rises from the valley to summits nearly 6,000 feet in elevation. The northern part of the property is one of bare irregular slopes cut by occasional dry gullies. The Penticton–Keremeos Highway crosses the east margin of the property. Workings on the *Something Good* and *A.C. Fractional* claims are reached by steep switchback trail half a mile in length, and those

on the *Sunrise* and *No. 2 Fractional* by a quarter of a mile of easy trail over drift-covered broken slopes.

The rocks are dark-coloured blocky cherts, quartzites, argillites, and greenstones. Intrusive into these are pyroxenite, aplitic granite, and diorite. The pyroxenite is a coarse green rock composed almost entirely of augite and including a little biotite; the largest body, on the *Something Good* and *Great Eastern* claims, is, at the elevation of No. 1 adit, nearly 2,000 feet wide, trending north-westerly up the hillside. A second body, of unknown extent, occurs on the *No. 2 Fractional*. On the north end of the property and about Olalla is a pink aplitic soda granite and also some diorite; the relationship of these several intrusives is not known.

On the *A.C. Fractional*, elevation 2,400 feet, and above, on the *Something Good* claim, elevation 2,590 feet, are two adits. The lower adit, 315 feet long, bearing south 73 degrees west, is in pyroxenite. The upper adit is in sediments 30 feet south of the large body of pyroxenite, and is 40 feet north of a 100-foot offshoot of the same rock, which may be traced 400 feet up the steep slope and which joins the main body just above the lower adit. The upper adit when examined was 255 feet long at about south 70 degrees west, and a crosscut was in 12 feet to the north at 185 feet from the portal. The adit follows the southern, steeply-dipping foot-wall of an irregular shear-zone. This is about 4 feet wide at the portal, widens to 16 feet about 40 feet above, and widens still more higher up precipitous bluffs; 100 feet or so up the bluffs the zone splits and cannot be located with certainty beyond this point. On the surface, except at the constriction in the portal of the adit, this zone is seen to be a thoroughly cemented breccia of cherty to finely quartzitic rock; cementing material is sparse to absent and mineralization consists of a slight amount of pyrite. In the adit, although the full width of the zone is not shown, there is a foot-wall seam of fine crushing to a maximum width of 25 inches; in this material there are few fragments greater than an inch in size, and much is the size of coarse sand; there is both calcite and quartz cement, and fine, sparse pyrite occurs principally in the cement. About 100 feet from the portal the foot-wall zone is less marked, and in the inner 100 feet the drift, although following a recognizable foot-wall, is in sheared argillaceous sediments. Two samples across the face taken when the adit was 170 feet long returned 0.01 oz. gold per ton. Two samples of the foot-wall zone: (1.) Eighty-five feet from portal, 26 inches wide: Gold, 0.37 oz. per ton; silver, trace. (2.) Sixty-seven feet from portal, 22 inches wide: Gold, 0.74 oz. per ton; silver, 0.4 oz. per ton. Two grab samples from the ore-bunker at the foot of the hill returned trace each in gold.

A small home-made bucket tram has been used to transport ore from No. 1 adit to a bunker near the road. A portable compressor supplied air to No. 1 adit during the late summer of 1936.

On the *Sunrise* and *No. 2 Fractional* are quartz veins in granite, diorite, and in or near pyroxenite. On one vein, in granite, is a 90-foot adit on the roadside, bearing south 75 degrees west, which shows a tight-walled nearly-vertical vein 5 to 16 inches wide and containing a very little cubical pyrite. A shaft, 250 feet to the west, said to be 45 feet deep, is on the same frozen vein 8 to perhaps 20 inches wide. This may or may not be the same as a vein 8 to 18 inches wide exposed in an open-cut on the *No. 2 Fractional;* this vein is sparsely mineralized and occurs between walls of fine diorite. An adit 100 feet lower (elevation 2,000 feet) and 150 feet north was 97 feet long, bearing south 15 degrees west, at the time of the writer's visit. Another vein of white quartz is poorly exposed about 100 feet easterly from the adit. There are few outcrops in this locality.

Stump Lake Area.

Nicola Mines and Metals, Ltd.

This company is capitalized at $2,500,000, divided into 5,000,000 shares of a par value of 50 cents each. The head office of the company is 1015 Rogers Building, Vancouver. P. L. Bancroft is president and managing director and T. B. Cosgrove is mine manager. The property comprises twenty-six claims, twenty-three of which are shown on the accompanying map, and three others, *Big Sandy*, *Empire*, and *Maiden*, lie to the east of the main group.

The property is on the south-east shore of Stump Lake and lies partly on the western flank and summit of "Mineral Hill." It is 31 miles north of Merritt and about half-way between Merritt and Kamloops. A good road some 2½ miles in length connects the mine with the main highway.

Relief on the property is 300 feet in a region of bare or sparsely-wooded hills. Rock bluffs locally flank the lake and elsewhere the rise is in grassy, drift-covered slopes. Water for plant use is pumped from Stump Lake and for drinking purposes is hauled from Scott Creek, some 3 miles to the east. Timber, consisting of pine and fir, is scanty, but sufficient for present needs.

The general geology is extremely simple: the rocks consist of greenstone of the Nicola formation, which underlies the entire property. The Nicola greenstone is an andesitic rock, usually fine-grained and rather bright green in colour; locally it is coarser-grained and is dioritic to diabasic in texture. The rock is all altered (chloritized), but is on the whole massive and is only locally sheared. Included in this formation are occasional bands of tuff and breccia; the former are extremely fine-grained, finely-banded rocks which may be difficult to distinguish from the finer-grained phases of massive greenstone; the breccia contains andesitic fragments, up to fist size, similar in composition to the matrix.

The greenstones are steeply tilted in the vicinity of the principal workings. They strike north 40 to 60 degrees east and dip nearly vertical. Just north-east of the property boundary an exposure of tuffs shows a nearly flat attitude. The major structure is not known.

The veins are quartz-fillings in shear and fracture zones, and are usually accompanied by rather prominent alteration of the wall-rocks. Younger than the veins are hornblende-andesite dykes, dark in colour, some of which are faintly porphyritic and some are fine-grained, holocrystalline. These dykes are from a few inches to 7 or 8 feet wide and are irregular in attitude. They cut the veins and tend in some cases to follow the vein-fissure.

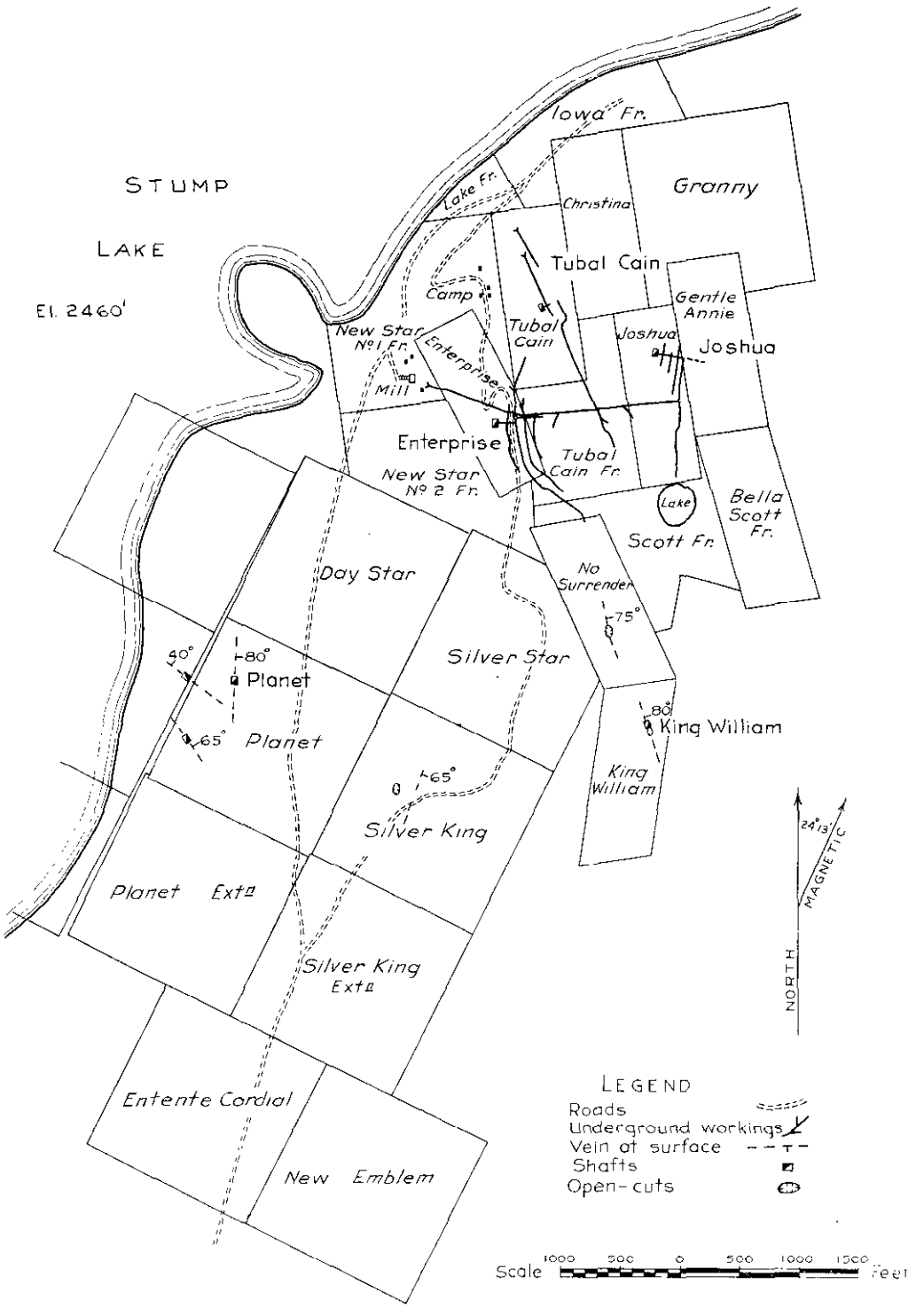
A number of veins are known, which strike northerly and dip easterly. Two veins dip north-easterly and strike at a large angle to the average trend. (*See* accompanying map, which is from company surveys, with mine-workings brought up to date by the writer.) Of the principal veins, the strike varies between north 45 degrees west and north 25 degrees east and the dip between 45 degrees easterly and vertical. They are quartz-filled fractures and shear-zones in which there has been in most instances an alteration of the wall-rocks. They are free-walled and vary in width from an inch or two to 6 feet, and pinches, swells, and changes in attitude are characteristic. The walls are bleached and pyritized and do not carry appreciable values; the total width of alteration-zone is not constant, but may attain a thickness of 15 feet.

The quartz is white and vitreous and is mineralized irregularly with sulphides which include pyrite, galena, sphalerite, tetrahedrite, chalcopyrite (bornite). These occur in segregations, thin seams, and disseminations which make up usually a low proportion of the veins. Gold and silver values are rudely proportional to the amount of sulphides in any one vein, but the sulphides vary in amount and proportion in different veins. Calcite is found as vein-filling only in the *Joshua* vein at the south end; it occurs also as fracture-fillings in wall-rocks but is not abundant. Scheelite is reported as of rare occurrence in the *Joshua* vein.

"Mineral Hill" is mentioned in the earliest available reports, and claims were there staked between 1882 and 1885. Prior to 1890 the Nicola Mining and Milling Company put down or started the *Joshua*, *Tubal Cain*, and *King William* shafts, and the Star Mining Company put down the *Star* (now *Enterprise*) and *Planet* shafts; a small concentrating plant was erected by the latter company. Work by these two companies was discontinued, and from 1889 to 1916 no serious work was done on this ground.

In 1916 the Donahue Mines Corporation, of Seattle, acquired eight claims and commenced investigation of the *Joshua* and *Tubal Cain* veins. In the following year a mill was built and three cars of concentrates were shipped, but the mill was shortly closed down. During the next three years a little work was done by the same company, and finally, in 1920, after shipping 62 tons of ore, operations were suspended.

Work was again started on the *Enterprise* (formerly known as the *Star*) vein in 1925, and by 1928 the Planet Mines and Reduction Company of Nicola, B.C., Limited, had deepened the shaft to 320 feet, had started an adit-crosscut at that level, and was building a mill. Milling commenced in 1929, on ore from the shaft-dump, shortly before the *Enterprise* vein was intersected by the crosscut adit, and from then on development was hard pressed to keep ahead of a mill consumption of 60 tons a day. The company finally abandoned operations in February, 1931.



Nicola Mines and Metals, Ltd. Plan of Property showing Principal Veins and Underground Workings, adapted from Company's Surveys.

Nicola Mines and Metals, Limited, was incorporated in 1928 and, following cessation of operations of Planet Mines and Reduction Company, acquired the eleven claims held by that company, which, together with fifteen additional, made a total of twenty-six claims held. In 1933 the company, with conditional holdings, proceeded on a development campaign that included drifting on *Tubal Cain* and *Joshua* veins from the main 320-foot-level crosscut and sinking of the *Joshua* shaft from the original 400-foot level to a total depth of 755 feet. Development-work continued on the *Enterprise* vein and a winze was sunk to the 440-foot level. After shipping some 200 tons of concentrates in 1934 the mine was closed down in November, 1934, until July 10th, 1935, when, under new direction and management, operations were resumed. Operation has been continuous since the latter date.

Total production from 1928 to the end of 1936 has amounted to approximately 53,000 tons, of which 25,000 was mined by the Planet Mining and Reduction Company and the balance by the present company.

Six principal veins are known, each of which has received development. These are the *Joshua, Tubal Cain, King William, Enterprise, Planet,* and *Silver King.* Of these the *Enterprise* is by far the most important.

Tubal Cain Vein.—This vein strikes north 20 degrees west and dips 65 to 85 degrees easterly near the surface, and splits at depth to two members which diverge to the south; one of these is the almost vertical downward continuation of the vein at the surface, and one, the more easterly, has an average dip of 75 degrees easterly. At the surface a shaft, elevation 2,939 feet, is reported to be 170 feet deep, and from it a short level, now inaccessible, exists at 60 feet depth. An adit, elevation 2,832 and 510 feet north, is driven south to connect with the shaft and 110 feet beyond. A second adit, now inaccessible, elevation 2,740 and 200 feet north of the first, is 400 feet long. The vein in the upper adit attains a width of 2 to 3 feet in a number of shoots, usually not more than 20 feet long, between which widths may be 10 inches or less; one swelling in the vein near the shaft reaches a maximum of 4½ feet. The sulphide content is consistently low. Wall-rocks are strongly altered and shearing is fairly strong. An andesite dyke follows the vein throughout the length of the adit and crosses the vein three times; this dyke follows down on the steeper branch of the vein.

The *Tubal Cain* vein is intersected by the main crosscut on the 320-foot level of the present mine-workings (elevation 2,600 feet) as two steeply-dipping shear-zones 700 and 950 feet east of the *Enterprise* vein; this at a distance of about 1,000 feet south of *Tubal Cain* shaft. The nearly-vertical westernmost zone, with local reversals in dip, is one of strong shearing; it contains no more than occasional lenses of quartz and quartzose material over lengths of several feet and widths of rarely more than 10 inches. This zone has been drifted on for 380 feet south and 780 feet north of the main crosscut. The eastern zone is one of less strong shearing and alteration. It has been drifted on for 125 feet immediately south of the main crosscut, where not more than a few inches of weak quartz is to be seen. It has also been intersected and drifted on between distances 860 and 1,040 feet north of the crosscut. In the latter drift a 45-foot section, which lies beneath the upper workings, has been stoped to a maximum height of 25 feet, where there is a 5- to 8-foot zone of crushing and quartz-filling. The quartz attains a maximum width of 3 feet and is locally well mineralized. In the remainder of the drift very little quartz is to be seen.

Joshua Vein.—This vein fills a fracture-pattern of light shearing and some tensional openings that strikes north and dips about 60 degrees east. It is narrow and is accompanied by weak alteration; the vein-filling changes from quartz to predominantly calcite in the south end of the drift on 320-foot level. The quartz is frequently low in sulphides, but higher-grade shoots of irregular distribution and short length contain considerable sulphides, among which tetrahedrite is prominent. Widths up to 36 inches occur locally, although commonly the vein is 10 to 16 inches wide and narrower widths occur.

The vein is developed by a shaft (elevation at collar 2,925 feet) to a depth on the dip of 755 feet. Drifts are run from the shaft at 100 feet (110 feet north and 115 feet south), 200 feet (50 feet north and 160 feet south), 300 feet (140 feet north and 380 feet south), 400 feet (55 feet north and 210 feet south), and levels also are said to exist at 550 feet and 750 feet. The shaft is connected by a drift on the 320-foot level at a point 330 feet north of the main crosscut from the *Enterprise* workings and which is at an elevation of about 15 feet above the old 400-foot level. Below the 320-foot level the shaft is filled with water.

A little stoping has been done in the upper levels, but total production has been low. On the 320-foot level the north drift includes an inaccessible stope 120 feet long, from which a raise extends to the 300-foot level. The south drift shows an irregular vein with local segregations of sulphides for 245 feet, then a weak quartz vein for an additional 200 feet, from which point for 220 feet to the face is a 4- to 8-inch zone filled with quartz and calcite. Two faults occur in the south drift which move the southern segments 36 feet and 20 feet to the west.

The *Joshua* vein does not appear to be important as a producer. Local shoots occur which are reported to be of good grade, but these are discontinuous and are narrower than mining widths.

Planet Vein.—The *Planet* vein is seen only in and close to a shaft, elevation 2,620 feet, some 2,800 feet south-west of the *Enterprise* workings. The vein strikes north 3 degrees east and dips 80 degrees east. The shaft is said to be about 100 feet deep, but at present water-level is 35 feet below the collar. A zone of alteration, 4½ feet wide, contains a hanging-wall band of quartz 13 to 18 inches wide as well as two small stringers. In the shaft and 10 feet south of the collar the vein is narrow, and the quartz pinches down locally to a width of 8 inches. Channel samples taken by the writer on the north side of the shaft returned: (1.) Ten feet below collar, quartz 14 inches wide: Gold, 0.10 oz. per ton; silver, 5.2 oz. per ton; lead, trace; zinc, 0.02 per cent. (2.) Fifteen feet below collar, quartz 9 inches wide: Gold, 0.02 oz. per ton; silver, 3.2 oz. per ton; lead, trace; zinc, 0.06 per cent. (3.) Twenty-five feet below collar, quartz 12 inches wide: Gold, 0.80 oz. per ton; silver, 5 oz. per ton; lead, trace; zinc, 0.2 per cent.

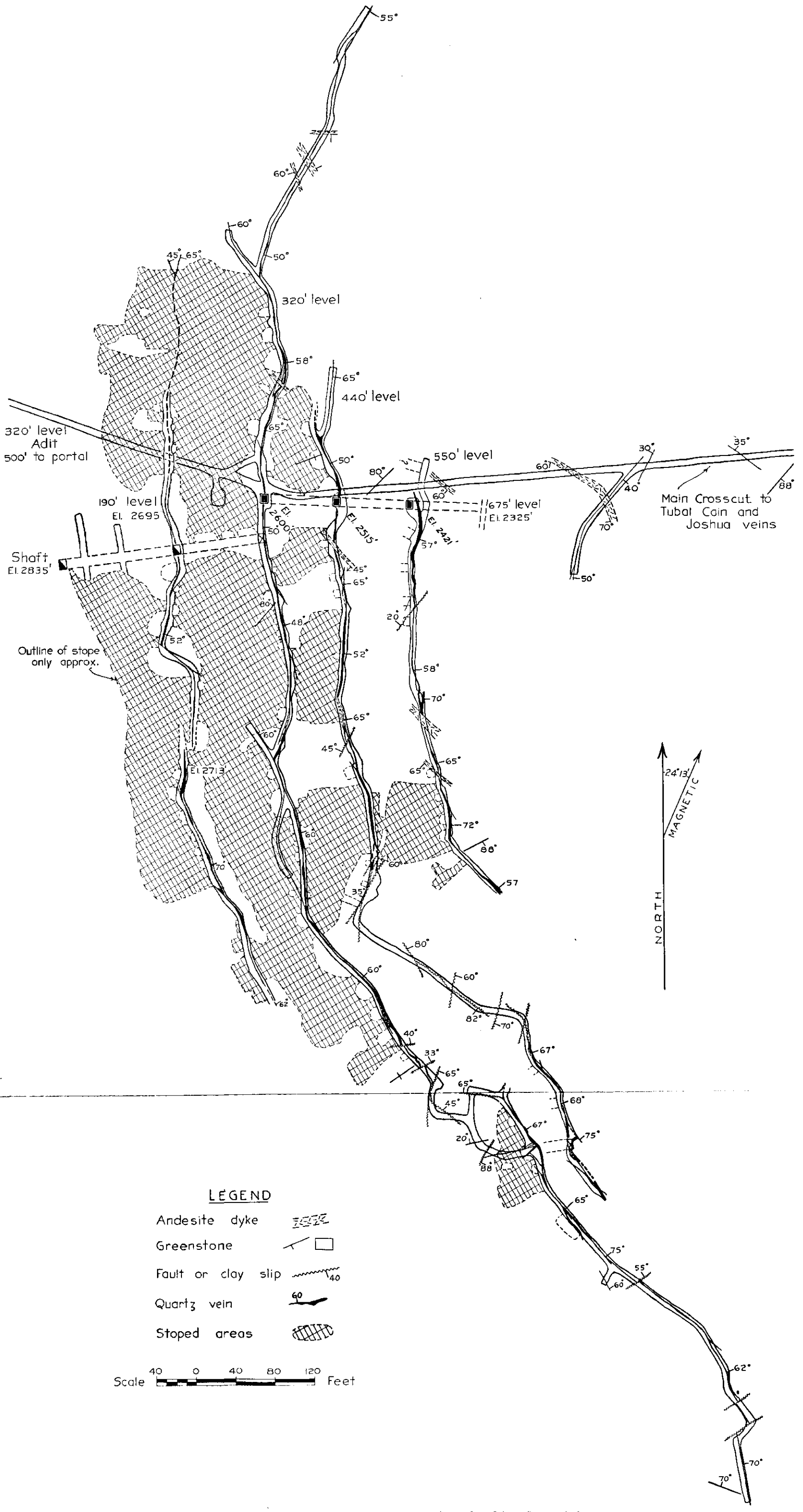
King William Vein.—This vein strikes north 20 degrees west and dips 85 degrees easterly where opened up by a shaft at an elevation of 2,900 feet. Levels, now water-filled, exist at 40 and 170 feet, and stoping on a hanging-wall split was carried to the surface. The quartz is 12 to 36 inches wide at the shaft, the greater width being related to the above-mentioned splitting. Immediately south of the shaft the present company, during 1936, mined a car-load of ore from a 30-foot cut to an average depth of 8 feet, in which the vein averages 18 inches in width. The ore was shipped direct to smelter as it was estimated to be of high grade, but results are understood to have been disappointing. High-grade samples are reported to be obtainable, but, while the writer did no sampling, there appears to be sufficient white quartz to offset the value of extremely high assays.

Eight hundred feet northerly from the *King William* shaft is an open-cut on the *No Surrender* claim which is very likely on the same vein. In this cut a 30-foot vein-length is exposed with a steep north-easterly dip; in the north end of the cut the strike is north 15 degrees west and in the south end is north 25 degrees west. A parallel strand 8 inches wide lies 40 inches in the foot-wall. The alteration-zone is about 7 feet wide and the vein, 20 inches wide, is well mineralized with galena, chalcopyrite, pyrite, and sphalerite. Two samples from the dump, taken by the writer, returned only low values in gold and silver. More work is here warranted to freshen up the 30-foot section of vein in order that it may be thoroughly sampled.

The *King William* vein strikes northerly under a heavy drift-cover so that prospecting is difficult. With due regard to respective differences in elevation and variations in strike and dip, this vein lines up well with the *Enterprise* vein, between the known extremities of each of which there is a horizontal gap of about 900 feet. (*See* general plan of surface.)

Other Veins.—On the *Silver King* claim is a vein which strikes north 20 degrees east and dips 65 degrees east, upon which a small shaft has been sunk (water-level at 25 feet). An alteration-zone, 4 to 6 feet wide or more, is poorly exposed. The vein is a few inches in width with an additional few stringers in the zone. Mineralization is weak and the quartz contains rock fragments. A near-by open-cut is caved, on the dump of which is some massive quartz with weak mineralization that apparently represents another vein; the alteration-zone is 6 feet wide.

West and south-west of the *Planet* shaft are two veins which dip north-easterly and on which a little work has been done. On the northerly of these, on the bluffs above Stump Lake, a 10-foot shaft discloses irregular quartz to a maximum width of 32 inches and a minimum width of 10 inches, containing sporadic sulphide mineralization. Two hundred feet easterly



Nicola Mines and Metals, Ltd. Plan of Enterprise Workings, adapted from Company's Surveys.

this vein is a few inches wide. The second vein shows 12 inches of white quartz between unaltered walls.

Enterprise Vein.—This is by far the most important vein on the property and the one from which practically all production has come. On the assumption that the *King William* is the same vein, the known length is some 3,300 feet, while in the present workings it has been developed over a north-south extent of 1,500 feet. The accompanying map of the *Enterprise* workings is from surveys by the company, and includes some correction and considerable addition by the writer, based on Brunton survey and direct observation.

The *Enterprise* vein differs in no material way geologically from those already described, except that it is rather more irregular. As so far developed the plan of the vein is crescentic, striking north-easterly in the northern and north-westerly in the southern section of the drifts; farther to the south the strike is more nearly north-south. Local variations in strike are numerous, and the dip varies between 40 and 80 degrees, averaging about 55 degrees in the centre of the area and steeper in the south. A few branches pass into the walls, but these have not proven important. Alteration of the walls is marked. Mineralization includes, in approximate order of abundance, pyrite, galena, sphalerite, chalcopyrite, tetrahedrite, bornite, occurring as bands or lenses parallel to the vein-walls, and also as disseminations throughout the quartz. The mineralization varies considerably in intensity.

The vein is characteristically irregular and changes in thickness are frequent. The vein may open up to a good width only to pinch down again with a change in strike or dip. These enlargements do not appear to be related to particular sections or to particular dips and strikes but are haphazard; perhaps more detailed study could furnish information of value concerning localization of ore-bodies. The vein attains locally widths of 5 to 6 feet, but is commonly much smaller; it is difficult to obtain an average, and the figure is not greatly important, but it is less than 2 feet. Mined sections are common in which the vein is about 16 inches wide. Ore-shoots are often as short as 20 feet, but on the 320-foot level ore has been mined continuously for a length of 820 feet. Ore-shoots appear to have, on a major scale, a rake to the south, but this rake is not everywhere in evidence. Most ore has so far been found on and above the 320-foot level, in the central section of vein which strikes nearly north and south. This section appears to shorten in depth, but development during late summer of 1936 indicates extension of good ore on the 440-foot level south of mined ore on the 320-foot level; an extension of ore in the south end of the 550-foot level indicates at least a partial effacement of a 250-foot barren section of vein on the 440-foot level above (*see* map).

Faulting on the vein is not severe and actual displacements are from a foot to 15 feet. This faulting is not, for the most part, strictly post-mineral, but is closely related in origin to the vein-fissure. Those barren sections of the vein on the 320- and 440-foot levels, 90 and 250 feet long respectively, at some 400 to 600 feet south of the winze, represent a zone of combined shearing and cross-fracturing which takes the place of the vein, but which is not continuous and does not represent strictly post-mineral faulting.

Original development on the *Enterprise* vein was by shaft, elevation at collar 2,835 feet, which was sunk for a distance of 320 feet on the vein. The present workings are served by an adit 760 feet long, which intersects the vein at an elevation of 2,600 feet and is about level with the bottom of the old shaft. This crosscut continues easterly to cut the *Tubal Cain* and *Joshua* veins, a total additional distance of 1,465 feet. A winze is sunk on the *Enterprise* vein at the intersection to a depth of 355 feet on the vein and from it are three levels: 440-foot level, elevation 2,515; 550-foot level, elevation 2,421; and 675-foot level, elevation 2,325 feet. At the time of the writer's visit, early in September, the shaft was being sunk towards the 675-foot level, which objective was reached about the middle of September.

Development includes, as at September 1st last, besides the shaft and winze, 700 feet of drifting on the 190-foot level, elevation 2,695 feet, the south end of which for 320 feet is 17 feet higher than the original drift. On the 320-foot level drifting is 490 feet to the north and 1,230 feet to the south of the winze, a total of about 1,720 feet; on the 440-foot level drifting amounting to 950 feet is all but 135 feet to the south of the winze; on the 550-foot level drifting of 460 feet is all but 50 feet to the south of the winze. Splits in the vein have been followed a short distance at several points on the 320-foot level.

Stoping has been carried on above the 190-foot level in two major sections, 210 feet and 300 feet in length, to a height north of the shaft of about 100 feet and south of the shaft nearly

to grass-roots. A small stope at the south end is about 30 feet high over a lengh of 45 feet. Between the 320- and 190-foot levels the vein is completely stoped out for a length of 220 feet north of the winze, thence south to the end of the 190-foot level, and for an additional 120 feet nearly to the same height as 190-foot level, making a continuous stope 820 feet in length. South of the barren section already referred to is a stope 90 feet long, now inaccessible, but about 50 feet in average height. On the 440-foot level all minable ore is stoped out north of the barren section of the vein in four stopes, 80 feet, 35 feet, 110 feet, and 70 feet long. South of the barren section a raise was being driven on September 1st to connect with the 320-foot level beneath the southernmost stope; this raise encountered good ore to widths in excess of 5 feet. On the 550-foot level one stope 75 feet long is mined out to 440-foot level, and three chute-raises started south of the winze on a promising section of the vein.

The writer took eleven samples of the vein proper in the *Enterprise* workings; these were all channel samples except No. 10.

(A.) On 320-foot level.

(1.) On south side of 10-foot winze immediately north of projected raise from 440-foot level south—37 inches: Gold, 0.20 oz. per ton; silver, 4.2 oz. per ton; lead, 4 per cent.; zinc, 5.2 per cent.

(2.) On north side of same winze—36 inches: Gold, 0.01 oz. per ton; silver, 1 oz. per ton; lead, 0.56 per cent.; zinc, 0.3 per cent.

(3.) Two hundred and twenty-five feet south of same raise—14 inches: Gold, 0.30 oz. per ton; silver, 1.5 oz. per ton; lead, 0.5 per cent.; zinc, 0.8 per cent.

(4.) Forty-five feet from extreme south end of drift—21 inches: Gold, 0.20 oz. per ton; silver, 4.6 oz. per ton; lead, 1.1 per cent.; zinc, 1.4 per cent.

(B.) On 440-foot level.

(5.) Twenty feet north of south raise—37 inches: Gold, trace; silver, 1 oz. per ton; lead, 1.3 per cent.; zinc, 0.6 per cent.

(6.) Thirty-five feet north of south raise—31 inches: Gold, 0.01 oz. per ton; silver, 1.6 oz. per ton; lead, 1.5 per cent.; zinc, 4.4 per cent.

(7.) Eighty feet north of south raise—29 inches: Gold, 0.12 oz. per ton; silver, 9 oz. per ton; lead, 1.5 per cent.; zinc, 2 per cent.

(C.) On 550-foot level.

(8.) Face of south drift—47 inches: Gold, 0.02 oz. per ton; silver, 0.4 oz. per ton; lead, trace; zinc, 0.1 per cent.

(9.) Sill-pillar in centre of south stope—27 inches: Gold, 0.76 oz. per ton; silver, 1.5 oz. per ton; lead, 1 per cent.; zinc, 1.5 per cent.

(10.) Chip sample at collar of 6-foot winze beneath same stope—18 inches: Gold, 0.12 oz. per ton; silver, 5.2 oz. per ton; lead, 3.5 per cent.; zinc, 2.6 per cent.

(11.) Sill-pillar at north end of same stope—17 inches: Gold, 0.10 oz. per ton; silver, 2 oz. per ton; lead, 3 per cent.; zinc, 1.5 per cent.

Mining has at all times been but little in advance of mill requirements. At September 1st, 1936, broken ore in the mine amounted in 550 south stope and 440 south raise to a total of about 350 tons. It is difficult to place reserves in the usual classes of probable and possible ore, particularly the latter, because the factors are rather uncertain at this particular stage of development regarding ground in advance of actual drift-faces. The presence of ore beyond these limits is more than likely, but it is impossible to assign to it concrete tonnage figures. The following figures refer to ore that is blocked out with reasonable certainty. Ore between 440 drift south and 320 level, 2,400 tons; between 550 and 440 levels beneath mined stopes, 2,400 tons; downward extension of ore to a depth of 50 feet below 550-foot level, about 3,500 tons; a total of 8,300 tons. These figures are based on average stope-widths and not on width of quartz alone. Ore reclaimable in pillars, due partly to filling of stopes and partly also to the fact that pillars are usually in lean sections of the vein, would not amount to more than several hundred tons.

Stopes are started from lagged-over drifts in some sections, and in others from chute-raises; little support is needed. Extraction is by open-stoping, with little broken ore at any time left in the stope. Stopes beneath working-levels are later waste-filled, more from convenience than necessity; most of the stoped-out ground between 550- and 440-foot levels is so

filled, and considerable of the ground between 440- and 320-foot levels; there is also some filling beneath the southern extension of 190-foot level.

There is considerable overbreaking in the stopes, due partly to the choice of method, and with very rare exceptions all material broken is milled. If the amount of dilution is to be kept to a minimum, some modified system of shrinkage-stoping that would allow of more selective mining and maintain narrow stope-widths would be preferable to the method at present in force.

A concentrating plant is located conveniently near the adit-portal, and ore is milled at an average rate of a little over 50 tons per day. Concentrates are hauled by truck to Nicola, and are sold, as from January 1st, 1936, to British Metals Corporation. Ore is trammed by hand to the 100-ton mill-bin; crushing is by jaw-crusher and rolls above a fine-ore bin of 100 tons capacity. Milling equipment includes a Hardinge ball-mill, Door classifier, Forrester pneumatic flotation-cells, Wilfley table, Dorr thickner, and American filter. A single concentrate is produced with a recovery of about 85 per cent. A Denver unit cell was installed in November with intent to improve recovery and also to slightly increase capacity of the mill.

A power plant for the entire operation is housed in the mill building. Other buildings include office, assay office, change-house, mess-house, and several small bunk-houses, in addition to which are several private dwellings. The combined operation employs about fifty men.

This property is dependent upon the *Enterprise* vein. Of the other veins, investigations to date have not shown that any considerable tonnage is to be derived from them. The *Tubal Cain* is a weakly-mineralized shear-zone of no great prospective value. The *Joshua* vein contains shoots that are minable at good metal prices, but tonnage from these will be low and necessary development-work fairly high. The *Planet* vein is little known and the shaft is not particularly encouraging, even in view of some high assays obtainable. This vein might be prospected on the surface by reliable geophysical methods to give an idea of the continuity of the vein-fracture, and to indicate position of the vein and depth of overburden as a preparatory step to stripping where cover is not too heavy. Extensive development of such a vein is needed before any estimate can be made of tonnage and values, because, as is obvious, minable ore is bound to occur in shoots which are not likely to be very large or continuous. The *King William* vein has promise, particularly when it is considered that it is probably the southern continuation of the *Enterprise* vein. It is not wide, but if as good as the known section of the *Enterprise* vein there is to be expected a considerable extension of minable ground. It is likely that overburden is too deep for economic stripping. The present condition of the 320-foot level is not good for the necessary long tram that would result in the continuation of the *Enterprise* drift to the south.

A glance at the general plan shows a tendency to convergence of the *Enterprise*, *Tubal Cain*, and *Joshua* veins both downward on the dip and to the south. An estimate of the actual location of the point of convergence is of little value, particularly in depth, because this point will vary in each section drawn, and it is even possible that there is no such convergence within economically reached limits. There is no reason, moreover, to believe that a convergence would mean a large or rich ore-body; in any event, the matter is one for investigation at a considerably removed date.

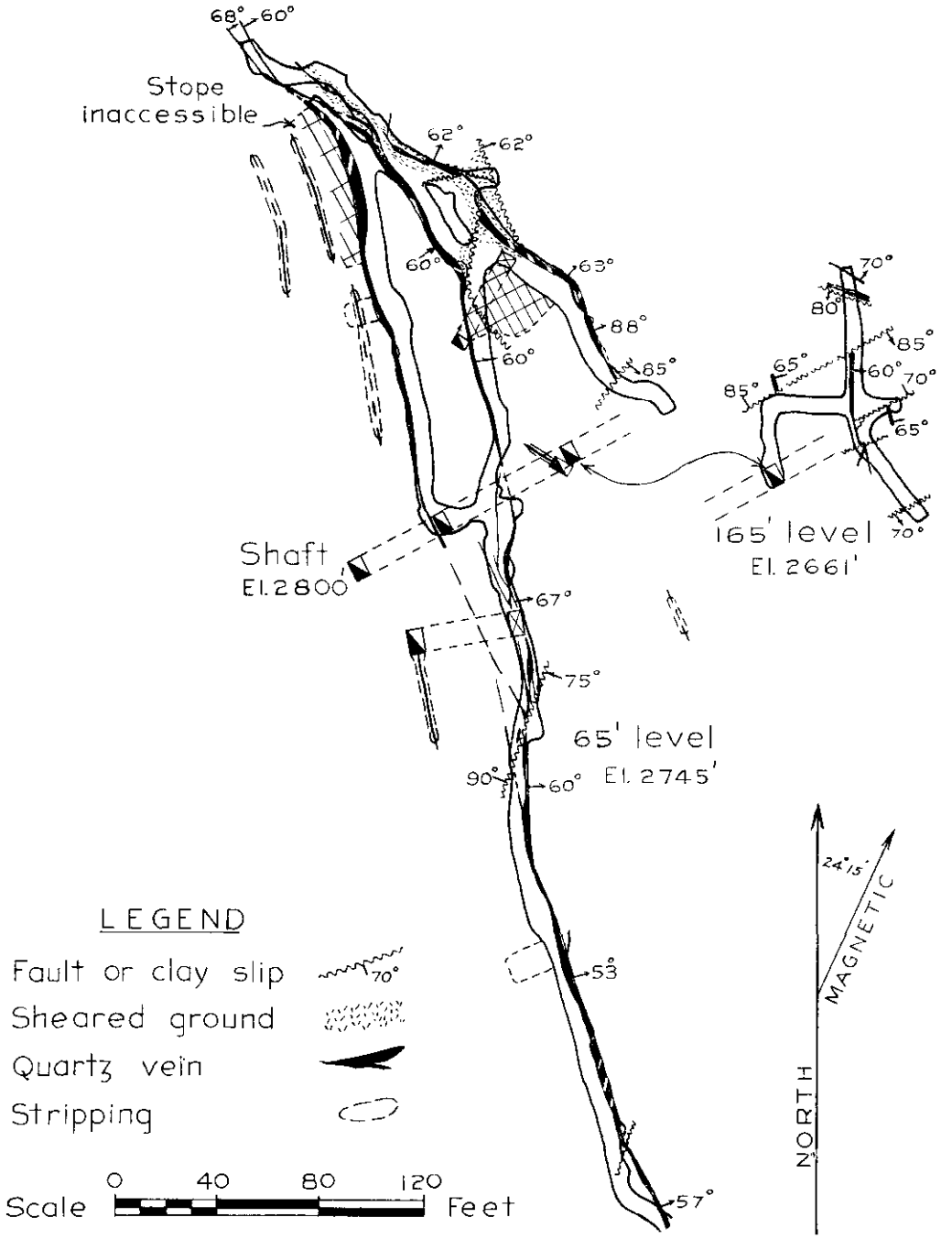
In the *Enterprise* workings development will have to be pushed aggressively if there is to be an assured tonnage for the mill to operate at present capacity. The new 675-foot level is now being developed and the southern extension on the lower levels should be investigated. Although the vein is not commercial on the 320-foot level north, this section has not been explored at depth; because of the rapid changes in vein-structure and of widths and value, this northern section should again be investigated from, probably best, the 675-foot level in the hope that ore-shoots may be found.

The life of the mine and success of the *Enterprise* is dependent upon systematized, efficient operation at low costs and accompanied by an active programme of development. Mill-heads are at present so low as to put the operation into the marginal class. The grade of mill-feed could doubtless be increased by adoption of a different method of extraction that would allow of cleaner, more selective mining. It is unlikely that increased milling capacity is warranted.

Jenny Long Mines, Ltd.

(*See* Annual Reports, 1933 and 1934.) This company controls a group of twenty-one claims, including the *Jenny Long*, Crown-granted. The property is about 3 miles south-east of Stump Lake and east of the Merritt–Princeton Highway. The region is one of open rolling range land in which the only

permanent stream is Scott Creek. The *Jenny Long* workings are at an elevation of 2,800 feet, a quarter of a mile south of the camp on Scott Creek, and are easily reached from the highway by a side-road 1 mile in length.



Jenny Long Mines, Ltd. Plan of Workings, from Brunton Survey.

The rocks are andesitic lavas of the Nicola formation, rather highly altered to a green, chloritic rock and locally sheared. The mineral deposits are quartz-filled shear-zones that form part of a rather complex pattern of shearing and fracturing. Vein alteration is not

strong and is not entirely restricted to walls of quartz. Mineralization includes pyrite, galena, sphalerite, tetrahedrite, and chalcopyrite in a gangue of friable quartz and a little carbonate. These sulphides vary both in relative proportions and in total amounts in different parts of the veins. The accompanying plan, from Brunton survey by the writer, illustrates the distribution of quartz and of broken ground on the two upper levels.

During the past season some development-work was done under the direction of J. F. Coats by Kootenay Nevada Mines, Limited, now in liquidation. At the time of the writer's visit the shaft was being sunk on contract and was, in early September, 40 feet below the 165-foot level. Since that date some drifting has been done on a new 265-foot level. The 35-ton mill was not operated in 1936.

Surface work, localized about the present shaft, shows two parallel north-south bodies of quartz and one trending north-west and south-east. One isolated open-cut shows a north-south strand of quartz not apparently related to the others. Six hundred feet south of this shaft is a 20-foot open-cut on a 2- to 6-inch vein dipping 70 degrees east; 90 feet north of this cut is an old shaft sunk 8 feet on a mineralized zone. Outcrops farther afield are very scarce.

The shaft is sunk on the foot-wall or most westerly of two north-south quartz veins. The average inclination of the shaft is about 56 degrees and the vein is followed for 90 feet when it leaves the hanging-wall of the shaft. This vein is drifted on for 180 feet to the north, where it joins a nearly parallel hanging-wall vein, and both swing to meet a north-west vein-zone. The north-south system is believed to be one rather than two "veins"; as illustrated in the plan, the foot-wall and hanging-wall bands converge to north and south. Over the total explored length of 500 feet this vein system or shear-zone attains widths of quartz locally as great as 6 feet, but averages less than 24 inches of quartz, the best widths being in the northern and southern sections of the drifts. A central, narrow, and branching section is probably too narrow to warrant mining. Some stoping has been done on the northernmost foot-wall section, and the back has been taken down to a height of 6 to 20 feet in several places. Shearing is most marked on the north, where the north-south and north-west systems meet. Here there are a number of strands of irregular quartz associated with both parallel and transverse gouge-seams of little displacement. The north-west vein-zone has been drifted on for about 170 feet to a point where it is cut off by a fault. Widths are as great as 2½ feet, and on one such section 28 feet long is a stope that has been raised on to the surface.

In the original development of the 65-foot level the vein was stripped. This has resulted in excessively wide drifts, and in most sections the vein is not in the best relation to the drift for stoping and chute-construction. Some of the ground, particularly in the northern part, is quite heavy.

The 165-foot level shows faulted north-south quartz and also north-west-trending quartz. It is evident that some of the faulting was contemporaneous with mineralization and does not simply displace the vein. Maximum width of north-south quartz is about 20 inches and that of north-west quartz where crosscut is 30 inches. The relation to the upper level is not clear.

Values, judging from the intensity and character of mineralization in different parts of the mine, must be erratic, and close sampling is necessary for determination of averages. Five channel samples taken by the writer on the 65-foot level north and north-east of the shaft returned low values in gold, silver, lead, and zinc, the highest being: Gold, 0.12 oz. per ton; silver, 6 oz. per ton; lead, 1 per cent.; zinc, 1.1 per cent. Some ore on the dump is heavily mineralized with tetrahedrite.

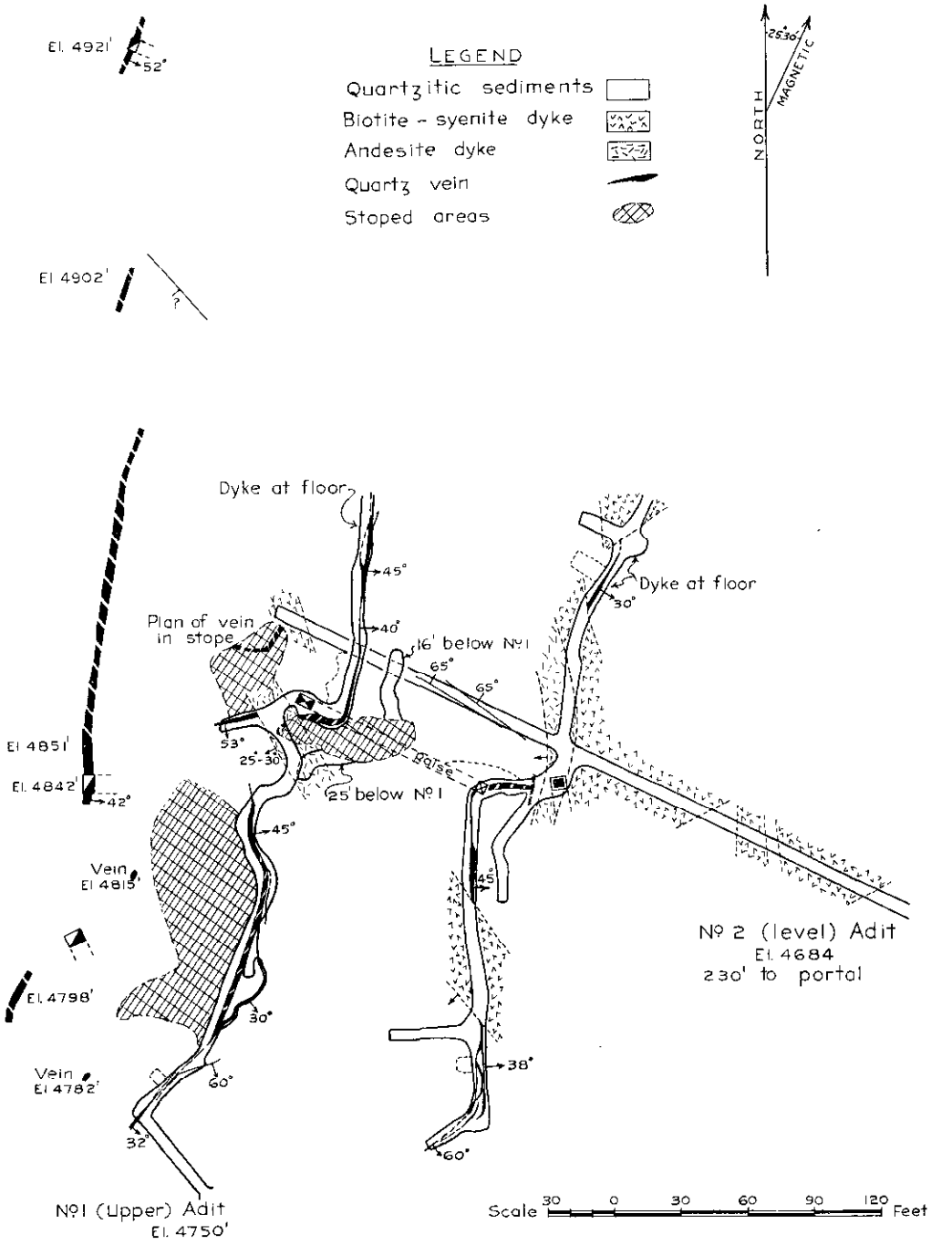
Jewel Lake (Greenwood) Area.

Greenbridge Gold Mines, Ltd.

This company controls a group of claims lying south and east of Jewel Lake. Work during the past summer has been restricted to the *North Star*, which is on the western edge of the major group and which is one of a group of five claims owned by Superior Mines, Limited, in 1935, and later acquired by W. E. McArthur, of Greenwood. The present company is in process of purchasing this group, which, with those already held, makes a total of thirty-one claims.

The *North Star* and *Cairn Gorn* were first bonded by Leslie Hill in 1897 and two shafts sunk, 50 and 60 feet respectively, on the vein. At a later date (not known) a crosscut 45 feet long was driven to intersect the vein below the shafts and a drift driven 125 feet on the vein. At a point about 45 feet along the vein some stoping was done and a shipment of ore made

to the smelter. In 1932 R. L. Clothier and associates, of Penticton, leased the *North Star* and shipped three car-loads of ore to Trail. In 1933 W. E. McArthur, of Greenwood, shipped a car-load of ore from the same stope and drove the main adit ahead, as well as a semicircular



Greenbridge Gold Mines, Ltd. Plan at North Star Workings, adapted from Company's Surveys.

side-drift on a branch vein. In 1934 the Superior Mines extended the main drift in a northerly direction through a porphyry dyke. (From Annual Report of the Minister of Mines for 1935.)

The *North Star* claim, elevation 4,700 feet, lies just east of the timbered, rolling summit of the mountain range flanking Jewel Lake on the east. It is easily reached by a branch road from Dentonia mine. Water is scarce, the nearest natural supply being a small stream 1,500 feet to the east, at which the camp is situated.

The mineral deposit is a north-south quartz vein dipping to the east and crosscutting a thick series of schistose quartzitic sediments. Syenite and andesite dykes of irregular shape cut both sediments and vein. The vein may be traced completely across the claim in a series of exposures of tight-walled rather barren quartz. As developed underground the vein is erratic; a maximum width of 4 feet is only attained locally, and some sections are less than 4 inches in width. Mineralization consists of pyrite, galena, chalcopyrite, sphalerite, and telluride in frequently crystalline quartz. Ore-shoots are not continuous and are localized principally at abrupt changes in attitude of the vein.

The accompanying map, drawn from transit surveys by the company and with level detail added by the writer, illustrates the geology of the ground. No. 1 adit is driven on the southern boundary of the *North Star* claim. On the surface, on the south, the vein outcrops as heavy barren quartz, and one caved shaft and some surface work do not clearly indicate the structure. In the second shaft 4 feet of white quartz is followed down at 42 degrees dip, and at 25 feet is 12 inches wide; rich pockets occur in this shaft. North, so far as shown, the vein is steeper and is comparatively straight. Mineralization as seen in surface strippings and at the collar of the northernmost shaft is scanty.

Underground the behaviour of the vein is different; it is a highly irregular structure, with commercial ore localized where the irregularities are most pronounced. Dykes are of two sorts; one, the most prominent, is a biotite syenite brownish in colour and sometimes porphyritic when of medium grain, but grey in colour when fine-grained. This latter phase of syenite is very similar in appearance to a medium and, locally, dark-grey andesitic dyke, and it is the writer's opinion that the two are closely related in age and origin. The syenite is evidently quite irregular, as in the No. 2 adit and north drift, where it occurs as a stock-like body. One sharp roll in the vein has been mined above No. 1 level, and between No. 1 and No. 2 on both sides of a post-mineral syenite dyke; in this section high-grade ore has been recovered. Another section has been stoped farther south above No. 1 level and is apparently worked out. Beneath this stope on No. 2 the vein is weak, but some ore is bound to occur between the two levels.

The combination of irregular vein and post-mineral dykes makes for difficult development in this section and, except for ground beneath the larger stope on No. 1 level, the future of the mine depends on the northern continuation of commercial quartz. A winze, now water-filled, sunk near the No. 1 crosscut, is said to be about 45 feet deep. Some promising ore is reported from this winze which must be in sediments between the two diverging dykes, a condition faintly suggested on the level.

Samples taken by the writer returned: (1.) From underhand stope 12 feet below sub-level drift north, quartz 24 inches wide: Gold, 0.40 oz. per ton; silver, 1.6 oz. per ton; copper, trace; lead, 1.3 per cent. (2.) In sub-level drift north, 15 feet north of roll in vein, quartz 29 inches wide: Gold, 0.10 oz. per ton; silver, 0.1 oz. per ton. (3.) No. 1 north drift 28 feet from face, quartz 24 inches wide: Gold, 3.90 oz. per ton; silver, 16.5 oz. per ton. (4.) Grab sample of fines in small upper stope: Gold, 0.20 oz. per ton; silver, 1 oz. per ton; copper, *nil;* lead, trace. (5.) No. 1 level in bottom below stope, opposite split in vein, 16 inches quartz: Gold, 0.36 oz. per ton; silver, 0.8 oz. per ton; copper, trace; lead, 0.5 per cent. (6.) No. 2 level south drift at short raise, 8 inches quartz: Gold, trace; silver, trace. High values appear to be related to tellurides.

A crew of four men shipped three cars of picked ore during the past season principally from the stope beneath No. 1 level. Electric power is obtained from the West Kootenay Power Company, and air is supplied by a 230-cubic-foot compressor driven from a 50-horse-power motor.

Midway Area.

Rainbow, Riverview, etc.

These claims, 2 to 4 miles north-west of Midway, are owned severally and collectively by D. Murray, of Beaverdell, and by W. D. Murray and Frank Thompson, of Midway. The claims are staked along a roughly east-west line on or just below mountainous summits at about 3,500 feet elevation.

On the north-west edge of the upland area the ground is sparsely timbered, broken, and hilly; to the east a higher. prominent mountain range drops in long broken slopes towards the Kettle River. A road leads to the upland area and from it any part of the ground is reached on foot or on horseback without difficulty.

The geology is not well known, as it has never been studied in detail. The most striking feature is a band of dolomitic limestones that strikes east-west and is about a quarter of a mile wide. Outcrops are scarce, but on the west these rocks are in contact with andesite, apparently bedded with the sedimentary series. The whole is cut by intrusive serpentine and by a variety of dioritic dykes. The limestones are in many places mineralized with sphalerite, galena, pyrite, and occasionally chalcopyrite at and near contacts, and also apparently well within the limestone. One quartz-porphyry dyke is known to contain a mineralized zone carrying gold and silver values. In the central part of the area, on the *Elinor* and *Ethel* claims, ribs of silicification and bands of chert breccia are seen in two or three places in the limestone that are very similar to some of the "jasperoidization" encountered in the Phoenix Camp.

On the *Rainbow* claim on the extreme north-westernmost edge of the mountain-mass an east-west vertical zone has been stripped to show a 20-inch band quite strongly mineralized with galena and sphalerite. This is in altered, talcose members of the limestone series close to a contact with serpentine. For 300 feet north-east stripping shows narrow bands and small patches of the same sort of mineralization. On the *Ida*, to the east, sulphides are found associated with calcite stringers at a contact with andesite.

Half a mile farther east, on the *Broadview*, occasional outcrops and small strippings on grassy hillsides show traces of sphalerite and galena in limestone and also a little quartz as stringers and breccia-filling. On the *Riverview*, half a mile east of the road and overlooking Kettle River, is a quartz-porphyry dyke, apparently about 200 feet wide and striking east-west. In this dyke there is pyrite and some galena, which are found also in adjacent limestone. In one cut on a steep-sided east-west ridge an oxidized mineralized zone is opened up over a few feet, but, due to oxidation, the character of the zone is hard to determine. A sample over 25 inches in the face of a small cut returned: Gold, 0.40 oz. per ton; silver, 23.5 oz. per ton; lead, 0.2 per cent.

Okanagan Lake Area.

Iron Horse. This group of seven claims is owned by Otto and Pete Sandberg, of Kelowna, and associates. It is between the forks of Deep (Peachland) Creek near the summit of a prominent ridge between 4,500 and 4,700 feet elevation. The south side of the ridge is steep and bluff-covered, and the north side is one of broken rolling slopes. Timber is plentiful but water is not. The ground is reached by trail about 1 mile in length from the road on the South Fork of Deep Creek, 9 miles from Peachland.

The rocks are principally limestones with less argillites and lime-silicate rocks, and are intruded by granite. Granite is abundant in the district, and many areas of sediments, including these, are remnants of former roofs of the batholithic rocks. The sediments are mineralized with pyrite, pyrrhotite, chalcopyrite, arsenopyrite, sphalerite, and galena in the form of disseminations, replacements, and, rarely, veins. Garnetite is not abundant on the claims, but is prominently developed half a mile to the south-east.

On the south slope, elevation 4,450 feet, in limestone, is a 10-foot vein, strike south 70 degrees west, dip 55 degrees northerly, of heavy pyrite, pyrrhotite, chalcopyrite, and arsenopyrite. The vein is exposed by one open-cut and a little stripping over a length of about 200 feet, and appears never to have been traced any distance beyond, although it is a strong structure. On the east side of the ridge, near the crest, a 12- by 6-foot cut shows nearly massive pyrrhotite containing some chalcopyrite occurring as a replacement in gritty argillaceous rock; size and shape of the mineralization are not apparent. Two hundred feet westerly from this cut is a little stripping that shows pyrite, chalcopyrite, pyrrhotite, and considerable sphalerite, occurring apparently as a flat body bedded in limestone and only partly exposed. Samples taken at each of these localities returned very low values in gold and silver and trace to 1.5 per cent. copper. Although no large body is indicated, the diversity of mineralization in such a geological setting warrants further stripping to investigate the amount of mineralization and possibility of commercial values.

Paulson Area.*

Molly Gibson. This property, formerly known as the Molly Gibson, Burnt Basin, consists of the following mineral claims: *Molly Gibson, Molly Gibson Fraction, Grey Eagle, Irish Nellie, Manchuria, Pip, Tip Fraction,* and *Grey Eagle Fraction,* at present owned by the Molly Gibson Mines, Limited, Grain Exchange Building, Calgary. Previous descriptions of the property may be found in the Annual Reports of the Minister of Mines for 1917, 1920, 1922, 1923, 1926, 1928, 1929, 1930, and 1933.

The workings are situated 4½ miles south-west from Paulson, a station on the Canadian Pacific Railway, some 33 miles north-east from Grand Forks. They are on a summit, from ½ to 1 mile south of the headwaters of Josh Creek, and between elevations of 4,800 and 5,200 feet, and may be reached from Paulson by a narrow-gauge wagon-road that leaves the main Grand Forks–Paulson Road about 1 mile south of Paulson, and climbs 1,200 feet in the last 3½ miles to the property. From the highway the first 2 miles of the road is along a very steep side-hill that forms the west valley-wall of McRae Creek; the remaining distance goes over the summit and along fairly level ground.

In the immediate vicinity of the workings the ground slopes gently northwards to Burnt Basin, but 1,200 feet northward from the main shaft, a very steep and bluffy hillside slopes for 2,000 feet into the narrow valley-bottom of McRae Creek in vicinity of Coryell Station.

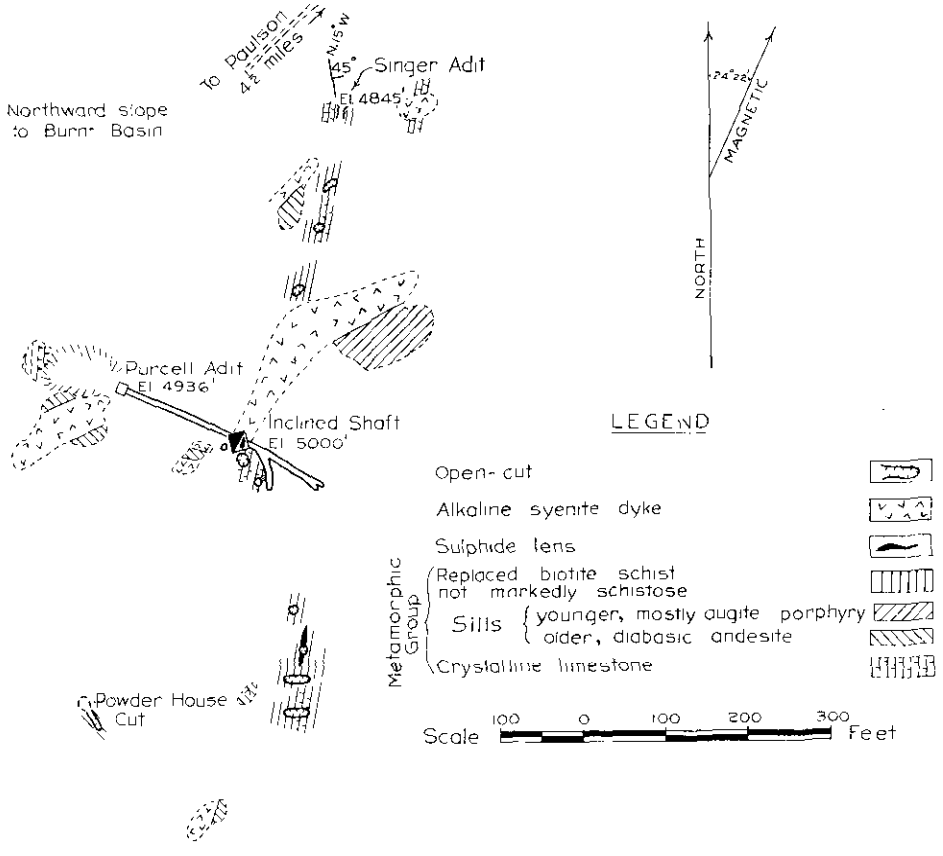
The rocks in the vicinity of the workings include altered and silicified limy sediments, crystalline limestones, two varieties of older fine-grained and porphyritic alkaline-syenite dykes. Excepting the syenite dykes, these rocks have regional strikes ranging from north to north 20 degrees west and dips from 45 to 75 degrees east. The distribution of these rocks may be seen on the accompanying plan. Southward beyond the area covered by this plan a large area of biotite monzonite, traversed by numerous syenite dykes, outcrops on the steep slope into McRae Creek.

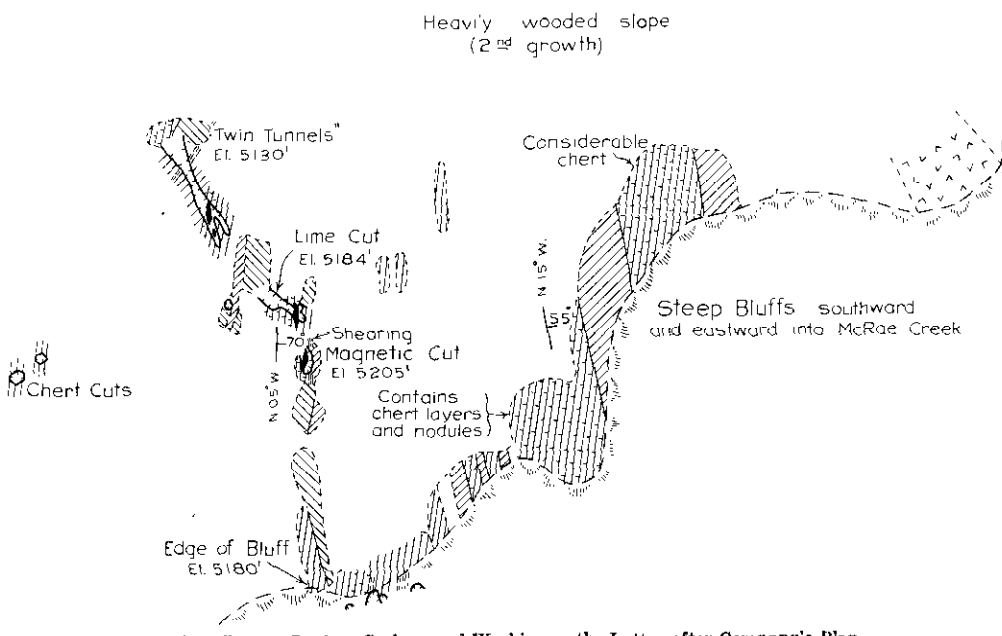
The group of metamorphic rocks is characterized by the presence of varying amounts of biotite and feldspar, but may be lithologically separated into biotite-schist irregularly replaced by calcic silicates, crystalline limestone, and andesitic sills.

The outcrops of the biotite-schist are dark grey in colour and frequently well laminated; whereas fresh, unweathered surfaces are chocolate-brown, frequently mottled by light-green patches and thin lenticular streaks of calcic silicates. Microscopic study of the different phases of this schist reveal the presence of the following minerals, listed in relative order of abundance: Biotite, calcite, medium-grained original, cherty, and coarse-grained later quartz, actinolite, diopside, orthoclase, anorthite feldspar, and very small amounts of sillimanite and scapolite. This rock represents a limy argillaceous sediment that has been subjected to both regional and contact metamorphism, differing in kind and in time of application. The regional type developed a predominant biotite-schist from the sedimentary rocks and a granular to porphyritic rock containing scattered flakes of biotite from the interstratified sills. The second and later type is contact metamorphic or, more correctly, contact metasomatic, insomuch as replacing calcic silicates and sulphides have been developed in the biotite-schists, whereby the schists were varyingly replaced by the green calcic silicates, producing a rock varying from a phase containing only thin streaks and veinlets, through one consisting of islands of unreplaced biotite-schist in a field of green silicates to one lacking all biotite and consisting of varying amounts of green silicate, patches of pinkish chert or jasper, well-crystallized calcite, hydrothermal quartz, and sulphides. It may be noted that some phases of the latter rock, phases which were undoubtedly quite limy sediments originally, are very hard and flinty and are seen to consist almost entirely of patches of chert alternating with patches of calcite. This rock is quite distinctive and has been locally called a jasperoid, relating it to the jasperoid in the Phoenix Camp, from which it differs, however, in having less jasper and containing disseminated pyrrhotite.

The biotite-schist and its altered phases are in sharp contact with conformable layers of well-crystallized and fairly pure limestone; layers that are both massive and laminated, and some silicified to dense, grey chert with perfect preservation of the fine laminæ of the original sediment.

* By J. S. Stevenson.





Molly Gibson. Surface Geology and Workings; the Latter after Company's Plan.

The sills may be divided into two closely-related types, neither of which is sufficiently chloritic to be called greenstone. One is an older, fine-grained phase, frequently laminated by closely-spaced joint-planes, that weathers to a light-green surface disclosing a felted mass of feldspar and light-green hornblende laths, which are now altered to an aggregate of chlorite fibres. The other phase occurs as narrow dykes cutting the first and as sills ranging from a few feet to 100 feet in width intercalated with the limestone-beds and conformable with the band of altered biotite-schist. The dark weathered surface of this rock is both granulose and porphyritic, the ¼-inch pyroxene-amphibole phenocrysts standing out conspicuously on the weathered surfaces. Microscopically it is seen to consist of light-green, chloritic amphibole, pseudomorphic after the original pyroxene, set in a granular ground-mass of flaky biotite, orthoclase, and anorthite. In contrast to the schist, neither calcic silicates nor sulphides have formed in the intrusive rocks.

The metamorphic group is traversed by a series of alkaline-syenite dykes that range in width from a few inches to 50 feet, the average of the long cross-country dykes being 50 feet. These dykes are prevailingly of a light, fresh colour and are definitely porphyritic. Among those seen on the property there were recognized: Augite syenite with prominent light-green, altered augite; biotite syenite with large brown biotite flakes; and amphibole syenite with shreddy, dull-green amphibole laths. All these rocks contain abundant orthoclase with varying amounts of plagioclase; but sulphides and calcic silicates are absent.

A large area of monzonite cut by numerous syenite dykes outcrops southwards on the *Manchuria* claim and forms the lower slopes of the hillside into McRae Creek; this intrusion of monzonite underlies the metamorphic group of rocks which strike southward into it.

The opinion of the writer is that the zone of mineralization is in a layer of highly-metamorphosed limy sediments which lie in the hanging-wall of a lenticular band of crystalline limestone about 10 feet wide, and are largely replaced by calcic silicates, patches of sulphides and quartz.

From observations made of unmined remnants of ore the habit was concluded to be as small lenses, probably 6 feet long by 2 feet thick by a maximum of a 10-foot length down the dip; these lenses occur along the strike of the horizon described. They are highly-silicified lenses containing a considerable amount of pyrrhotite with lesser amounts of chalcopyrite and pyrite. The altered zone, which in general carries small amounts of disseminated pyrrhotite, has been traced by surface workings for 1,600 feet southward to the face of precipitous bluffs; this same zone is, furthermore, also recognizable approximately 500 feet farther southward on the Singer property.

The property has been explored by an adit, the Purcell, which consists of 310 feet of drifts and crosscuts; by an inclined stope and vertical shaft to this adit, the collar of the shaft being 64 feet above the adit; by a new low-level adit, the Singer (38 feet long as of September 9th, 1936); by an open-cut and two short adits therefrom, "Twin Tunnels," 28 feet and 34 feet respectively in length; and by several open-cuts.

Ore has been found in and mined from the shaft, the "Twin Tunnels," the "Lime Cut," and the "Magnetic Cut"; however, by far the greater tonnage came from the shaft. The stope in the shaft represents the removal of approximately 800 tons of rock; how much of this was ore is hard to estimate. However, during the period 1909 to 1935, inclusive, 260 tons of ore was shipped; this would indicate that approximately one-quarter of the 800 tons was ore.

The original five claims of the *Molly Gibson* group were staked in 1905 and 1906 and the remainder in 1933 and 1936.

Shipments were made from the property as early as 1909; these were probably from the surface on the site of the present inclined shaft.

A crosscut, probably the beginning of the Purcell adit, was commenced in 1917, the object being to tap the inclined shaft. By 1919 this had been advanced 265 feet, and from the shaft a short drift had been driven on the ore; by 1922 the shaft was down 85 feet. During all this time some surface exploration was also done.

After 1922 little development-work appears to have been done until 1933, when the present programme of work was instituted. This has consisted of extending the Purcell workings, starting the Singer adit, and doing surface exploration.

Shipments of ore from the property made in the years 1909, 1920, and 1933 have aggregated some 260 tons, containing 285 oz. gold and 119 oz. silver.

The Purcell adit has been driven 255 feet in a direction south 60 degrees east to get under a zone of ore-lenses followed downwards by the old stope and shaft, the collar of which is some 64 feet above the adit. From the portal to the raise into the shaft, a distance of 165 feet, the adit is in the jasperoid-calcite phase of the schist, and carries a small amount of disseminated pyrrhotite. From this point a short working has been driven south 27 degrees east for 40 feet along the hanging-wall of a porphyritic biotite-syenite dyke that strikes south 25 degrees east and dips 50 degrees south-west; in the face of the branch working and in the hanging-wall of the dyke there is a 3-foot band of crystalline limestone that strikes north 20 degrees west and dips 40 degrees east. Southward the main working has been driven for 50 feet through an adjacent dyke of amphibole syenite, porphyritic but finer-grained than the biotite syenite. Striking north 15 degrees west and dipping vertically, it apparently cuts the biotite syenite. Beyond this dyke and for 15 feet towards the face a portion of biotite syenite again occurs, but the face of the main working and of a 15-foot working driven southward show banded limestone and partly replaced biotite-schist that strike north 10 degrees west and dip 50 degrees north-east. No important sulphide-lenses have been found in this adit.

The collar of the shaft and inclined stope is 64 feet above the adit. For approximately 25 feet from the surface, it is a small glory-hole averaging 15 feet in width in an east-west direction and ranging from 20 feet in length at the surface to 35 feet in a north-south direction at 25 feet down. From this depth the floor slopes at 20 degrees for 60 feet south-eastward, the back and the floor being only 7 feet apart in the last 30 feet, to a point connected by a 30-foot vertical raise with the Purcell adit, driven from a place 165 feet from the portal of the adit. Several small lenses of quartz-sulphide ore have been mined from this hole, and from the portions remaining it appears that most of them lay in the replaced biotite-schist above a 4-foot band of crystalline limestone. An irregular and lenticular stringer of quartz and pyrrhotite was seen in the southerly face in the usual silicated rock lying between the above-mentioned lens of limestone and a lower lens that lay on the biotite syenite forming the floor of the hole. This same syenite continues downward, crossing the vertical part of the shaft and appearing in the drift where previously described.

The failure in finding the downward continuation of the shaft ore in the adit is probably because that position occupied by it in the sedimentary horizon has not yet been tapped by underground work. The following bulk samples taken from the remaining portions of ore-lenses are only indicative of the precious metal content of such:—

	Gold. Oz. per Ton.	Silver. Oz. per Ton.
From a lens 3 feet long by 1 inch thick by 1 inch deep ...	0.04	Trace.
From a lens 2 feet long by 2 feet wide by 10 inches deep	3.10	0.1

The " Twin Tunnels " consist of an open-cut 50 feet long that has been driven through fine-grained, younger, fine-grained intrusives for 40 feet, then for 10 feet through a combined zone of silicated biotite-schist and limestone-pods to the portal of the underground work. This consists of two closely-spaced adits, one driven south 10 degrees east for 28 feet and the other south 20 degrees east for 34 feet, each through slightly laminated biotite-schist largely replaced by calcic silicates and containing small lenses and very irregular stringers of quartz and pyrrhotite. A sample taken across a lens 4 feet long and 14 inches thick assayed: Gold, 1.14 oz. per ton; silver, trace.

The " Lime Cut " has been driven for 20 feet through banded, crystalline limestone, then through 20 feet of largely replaced biotite-schist to the face, where limestone again occurs. No ore was seen in this cut, but the walls of a small 2-foot excavation midway along it contained small patches of pyrrhotite in a siliceous gangue, and it is reported that a small lens of ore was mined from here. In the " Magnetic Cut " some sulphide mineralization has been concentrated in an area 1 foot square in the altered rock adjacent to the hanging-wall of a crystalline limestone-band. A small bulk sample from this assayed: Gold, 0.76 oz. per ton; silver, 0.12 oz. per ton.

None of the other workings show lenses of ore; that is, lenses of highly silicified rock containing sulphides; they only show altered wall-rock containing disseminated pyrrhotite and occasionally an irregular discontinuous stringer of quartz. A small bulk sample of rock containing disseminated pyrrhotite assayed: Gold, trace; silver, trace.

At present (September, 1936) the company is driving the Singer adit, 155 feet below and 400 feet north from the collar of the shaft, along a layer of impure crystalline limestone in the hope of locating ore in the same zone as that explored by the shaft. It is quite possible that more lenses of ore comparable to those found in the shaft will be found in the same stratigraphic horizon below it on the level of the Singer adit. The cause for the localization of the lenses along the strike of the zone is not yet evident, and hence an approximate idea of the amount of ore on the property cannot be gained.

Chief among the problems of operation are: First, the absence of timber suitable for mining purposes, that existing on the wooded slopes being scrub second growth; and, second, an adequate water-supply; water for domestic purposes is at present obtained from springs of small flow.

SILVER-LEAD-ZINC DEPOSITS.

Beaverdell Area.

Golden. This group of three claims, the *Golden*, *Golden Fraction*, and *Rico Fraction*, is being developed by the Wallace Mountain Mining Company, an Okanagan syndicate. The group is on Wallace Mountain on the east bank of Dry Creek, half a mile south of the *Rambler* road. From openly-wooded, rolling, and locally broken country, the ground slopes steeply to Dry Creek, which flows in a narrow valley. Access is by a good trail half a mile in length. This trail leaves the *Rambler* road at the top of a steep hill above Dry Creek, and traverses drift-cover and very little bed-rock.

The mineralization is all within Westkettle quartz diorite, and consists of narrow, steeply-dipping east-west shear-zones, of which five are known. These contain galena, sphalerite, pyrite, chalcopyrite, tetrahedrite, and native silver in varying proportions. The gangue consists of rock, with varying amounts of quartz and (or) calcite in addition.

The principal work is on three parallel shear-zones about 50 feet apart, of which the central and south zones are stripped at intervals for 500 feet and the north one for 150 feet. At the east end, on the *Golden Fraction*, is an open-cut on the south zone 150 feet in length, from the west end of which a 53-foot adit is driven east. The zone is seen in this work to vary from a mere fissure to 24 inches wide and averaging perhaps 6 inches; a 14-foot section in the adit is 8 inches wide and contains considerable light-coloured sphalerite. A selected sample from the dump returned: Gold, 0.01 oz. per ton; silver, 247 oz. per ton; copper, 0.1 per cent.; lead, 26.5 per cent.; zinc, 22.3 per cent. At the west end of the line of stripping an adit was 34 feet long early in October, bearing 100 degrees. This was directed to locate the central zone and was at that time at the contact with an east-west andesite dyke, the relation of which to the zone was obscure. Fifty feet above the adit the zones are 3 to 18 inches wide and locally contain considerable quartz. A sample of the south zone in semi-leached material returned: Gold, 0.01 oz. per ton; silver, 112.6 oz. per ton; lead, 5.9 per cent.; zinc, 0.8 per cent. Samples of the quartzose material, sparsely mineralized with pyrite and galena, from the south and north zones returned traces in gold and silver.

Of two other similar zones, one, several hundred feet south-west from the large open-cut, has a shaft sunk 50 feet in 1935 and a short adit 250 feet to the west; the second zone has an old short adit just above Dry Creek and two cuts made in 1936. These two zones are less promising.

The season's exploration has been under the direction of William Faulkner. The three parallel zones are small and are in relatively unfaulted ground; their worth depends on there being a sufficient number of wider shoots to offset the undoubtedly narrow sections.

Coquihalla Area.

Coldwater. This group of five located claims is held by P. Y. Smith, of Princeton, and Dan Smith, of Vancouver. It is 4 miles north-west of Coquihalla Station and is three-quarters of a mile west of the Kettle Valley Railway. The workings are on the extreme western edge of the broad Coldwater Valley, at the foot of a long mountain-slope. A good trail leads from the railway on to a gravel terrace and across a nearly flat bench with few outcrops to the foot of the 20-degree sloping hillside. The workings are 150 feet above the flat and are 400 feet above the railway.

The rock formation is Eagle granodiorite of Cretaceous age, the contact of which, with Tulameen greenstones, lies some 2,500 feet north-east on the strike of mineralization. The mineralization consists of a narrow vein which strikes north 40 degrees east and dips 70 degrees north-west. The granodiorite is a moderately coarse-grained, massive grey rock in which, besides the known vein, there is occasional evidence of tiny frozen quartz stringers accompanied by traces of sulphide mineralization; some pyritic shear-zones a few inches wide occur half a mile to the south.

Workings on the vein comprise a little stripping and one open-cut, immediately below which is a short adit. The adit consists of a 43-foot crosscut bearing north 50 degrees west and drifts 15 feet north-east and 20 feet south-west; a connection has been made with the open-cut some 20 feet above. A second adit, 75 feet lower, has been faced off and would reach the vein in about 250 feet; the ground flattens off a little below this point.

The vein is a mineralized shear-zone between gouge-planes within faintly altered granodiorite walls. It varies in width between 2 inches and 12 inches and averages 6 inches. Sulphides include pyrite, galena, honey-coloured sphalerite, tetrahedrite, and, rarely, chalcopyrite; the gangue material consists of quartz and carbonate and, locally, of rock. The ore is frequently banded, and crustification and drusy cavities are common; quartz is finely crystalline to chalcedonic and the carbonate includes some rhodochrosite. The wall-rock contains pyrite in seams and scattered grains to a distance of several inches from the vein. Samples taken in the adit returned:—

(1.) Vein, 6½ inches wide, 25 per cent. gouge: Gold, 0.06 oz. per ton; silver, 19.2 oz. per ton; lead, 2.8 per cent.; zinc, 7.7 per cent.

(2.) Vein, 12 inches wide, 10 per cent. gouge: Gold, 0.06 oz. per ton; silver, 22.6 oz. per ton; lead, 2.1 per cent.; zinc, 4.9 per cent.

(3.) Vein, 7½ inches wide, 75 per cent. sulphides: Gold, 0.16 oz. per ton; silver, 16.8 oz. per ton; lead, 2.6 per cent.; zinc, 10.9 per cent.

(4.) Vein, 5½ inches wide, 90 per cent. sulphide: Gold, 0.08 oz. per ton; silver, 23.8 oz. per ton; lead, 6.5 per cent.; zinc, 14 per cent.

The vein is traceable as a narrow oxidized zone 750 feet north-east of the adit and is reported to extend a comparable distance to the south-west.

North Thompson Area.*

Homestake (Squaam Bay).

The *Homestake* group comprises three Crown-granted claims, the *Homestake*, *Maple Leaf*, *Troublesome*, and *Argentum*, and three mineral claims, the *Maple Leaf No. 1*, *Maple Leaf No. 2*, and the *Arrow Fraction*, staked in 1934 and 1935. The group is owned by the Kamloops Homestake Mines, Limited, 32 Fairfield Building, Vancouver. The property, on the Louis Creek–Squaam Bay Road, is approximately 3 miles north-westward from the head of Squaam Bay, on Adams Lake; or 18 miles easterly by auto-road from Louis Creek Station on the Canadian National Railway 36 miles north from Kamloops. The main adit is about 700 feet above the road and has been driven into the north-west side of a canyonous creek, Falls Creek, which is tributary to Sinmax Valley, the main valley leading south-easterly into Squaam Bay; the other workings are above this adit and on the same side of Falls Creek.

Steep V-shaped gulleys, combining to form Falls Creek, prevail in the vicinity of the workings, whereas a relatively unbroken hillside extends north-westward and south-eastward; this hillside, constituting the north-easterly side of Sinmax Valley, consists of steep, partly-wooded and talus-covered slopes.

The gully of Falls Creek and accessible slopes above expose a section of talcose-schist approximately 2,300 feet in thickness. The rocks exposed consist of talcose quartz-sericite schists and discontinuous, conformable lenses of phyllite, which strike north 40 degrees west and range in dip from 35 to 50 degrees north-east.

Three gradational facies of the quartz-sericite schist may be discerned—a fine-grained, fissile phase yielding talus of very talcose flakes, a nodular phase containing ovoid portions of talcose rock which may represent the squeezed pebbles of a conglomerate, and a finely fissile to platy phase that is partly chloritic. These phases probably represent gradational differences in the original sediments.

* By J. S. Stevenson.

The schists are well exposed and contain abundant pyrite. The exposed extent of a large cross-sectional area of pyritiferous schists has been conducive to extreme oxidation of the pyrite, resulting in sulphuric-acid solutions that have been further oxidized to yield the yellow ferric sulphate which so conspicuously coats the outcroppings and schist talus fragments on the walls of Falls Creek.

Where the bluffs steepen to vertical about 1,500 feet above the workings, the rock changes to platy greenstone which may be of igneous origin.

A zone in the quartz-sericite schist has been partly replaced by massive barite and sulphides; the barite preponderating in the foot-wall, known as the foot-wall lead, and the sulphides in the hanging-wall, known as the hanging-wall lead. These leads are commonly about 15 feet apart. Although some layers of the barite may range from 1 foot to a measured maximum of 31 feet in thickness, one band has maintained an approximately uniform thickness of 3 feet for an interrupted length of 200 feet. The number of bands in cross-sections of the lead ranges from one to a maximum observed of three; it is probable, however, that other sections may show more and narrower bands. The barite of the foot-wall lead, although massive, is banded by an alternation of dark- and light-grey bands, conforming in attitude to that of the replaced schist; schist-partings, however, separate the different bands. Under the microscope the barite is seen to consist of a mosaic of equidimensional grains which average 0.2 mm. in diameter; these grains are relatively free from twinning or gliding, which would indicate that the barite is of late formation, post-dating the general deformation and metamorphism of the replaced schists. Sulphides up to 1 per cent. in amount occur in discontinuous and indefinite bands parallel to the banding of the barite. The hanging-wall lead contains a greater amount of sulphides than the foot-wall lead and a greater amount of silver; it has constituted the ore in the mining operations to date. The lead, where exposed at present, consists of alternating bands of schist, barite, and sulphides, the proportions of which vary greatly from place to place. This lead is frequently cut by thin lenses of quartz that contain films of argentite in the fractures of the quartz. The sulphides include tetrahedrite, galena, sphalerite, pyrite, chalcopyrite, argentite, and a little native silver, listed in approximate order of abundance; ruby silver and native gold have been reported. Pyrite and chalcopyrite occur mainly in the hanging-wall lead; only an occasional grain being found in the foot-wall lead. The pyrite-grains are unbroken, indicating absence of intense post-mineral deformation, but replacement by the other sulphides tends to round the sharp corners of the cubes, and where well-advanced to leave spherical grains of pyrite; the pyrite ranges in grain size from 0.2 mm. (210 microns) to 0.02 mm. (20 microns). Areas of sphalerite, galena, and tetrahedrite are in mutual contact, individual areas not being less than 0.3 mm. in diameter; they usually present smooth, curving boundaries to each other. Argentite does not occur as an intergrowth in the galena, but usually as thin films loosely adhering to the joint-planes of the quartz, which frequently occurs as veinlets in the schist of the hanging-wall lead.

The discovery of the Homestake mineral-showings was made in Falls Creek in the summer of 1893, and between that year and 1895 development was in progress, and it is reported that 20 tons of high-grade silver ore was shipped. In the old reports no mention is made of further active work until 1918, when it was bonded by Eastern interests and hand-mining carried on by H. D. Cameron until 1919, when the option was dropped and work ceased. Again in 1923 the property was bonded to J. Trethewey, of Abbotsford, and associates, and worked by them through 1924, but then dropped. Up until this time most of the work had been done east of the main fault, but Tretheweys are reported to have proved ore for 200 feet westward from the fault. In 1925 W. J. Bell reopened the workings, and between 1925 and November, 1927, when he ceased operations, shipped a considerable tonnage of ore. Bell stoped ground extending for approximately 150 feet westward from the main fault to the present No. 3 raise and from the main drift for about 110 feet up the dip of the schists. At the eastern end of this stope the lead is only a short distance from the surface, but in the vicinity of No. 3 raise it would be about 275 feet along the dip from the surface. Because of the variability in width and sulphide content of the hanging-wall lead, the amount of ore in this unstoped area is indeterminate. Bell also operated below the main level, on what are known as the 40-foot, 75-foot, and 150-foot levels, connected by a winze; but according to reports ore higher than 25 oz. silver was not located. In 1935 the property was reopened by the Kamloops Homestake Mines, Limited, which erected a mill of 30–40 tons daily capacity. This company cleaned out

the main adit and sank a winze from near the north-westerly end of the foot-wall drift. The writer understands that this winze was sunk for about 85 feet and a sinuous drift driven south-eastward in an attempt to connect with the old workings on the hanging-wall lead; extremely bad ground apparently militated against the successful completion of this work. Operations by the company ceased in the spring of 1936. References to the Homestake property, Squaam Bay, may be found in: Geological Survey of Canada Annual Reports, 1894 and 1921, and the Annual Reports of the Minister of Mines for 1893, 1895, 1897, 1913, 1917 to 1919, 1922, and 1930.

The workings consist of three adits. The lowest and main adit is approximately 700 feet higher in elevation than the highway; the middle or Apex adit is 72 feet above the main adit and the uppermost is 77 feet above the Apex.

Extensive parts of these workings were caved at the time of the writer's examination. The workings accessible in the main adit included the main entry-crosscut, workings lying easterly from the main fault, the drift along the foot-wall barite, No. 4 and the uppermost part of No. 3 raises.

The main adit has been driven north 20 degrees east for 240 feet to intersect the hanging-wall and foot-wall leads. At 110 feet from the portal a drift has been driven along the foot-wall lead north-westward for 300 feet; another drift 170 feet from the portal north-westward along the hanging-wall lead a similar distance (this drift was entirely caved); at 160 feet from the portal a drift east for 55 feet along what is probably the foot-wall lead; from this drift a raise and winze have been driven from a point 20 feet easterly from the main adit; and 10 feet farther along a crosscut has been advanced 60 feet north-eastward.

In that drift going north-westward from a point 110 feet from the portal, and between points 50 feet and 100 feet north-westerly from the main adit, barite is continuously exposed; it strikes north-west, dips 30 degrees north-easterly, and averages 3 feet in width; but the drift, going westerly into the foot-wall, loses the barite and does not encounter it again until within 80 feet from the face, where a band of barite averaging 4 feet in width was followed for 45 feet until the drift turned into the hanging-wall for 30 feet to the face. Auxiliary workings from this drift include: At a point in the drift 50 feet north-westerly from the main adit, a raise (caved) and a short working going 30 feet in a direction north 75 degrees west, with a raise driven from it for 17 feet vertically into the hanging-wall, and then south 70 degrees west for 33 feet on a 30-degree slope. This raise is in a lens of barite, varying from 3 feet to 1 foot in thickness and cut by a strike-fault which dips 45 degrees east; the barite-lens dipping 30 degrees—at 95 feet a caved working driven north-westward—at 220 feet a raise (No. 4) has been driven beyond and above the band of barite that had been encountered in the drift below and for 14 feet along a zone, 2 to 3 feet in width, of interbanded sulphides, barite, and schist, which constitutes the so-called hanging-wall zone. This has been followed for a short distance by a 20-foot drift south-eastward connecting this raise with No. 3 raise, now caved below, but accessible on a 25-degree slope for 31 feet to its face; thin 1-inch bands of mixed sulphides and barite were seen in this raise, but they disappear before the face is reached. Presumably the raise, which is on a 25-degree slope, has been driven into the foot-wall of the zone; much of the ground to the south-east of No. 3 raise is reported to have been stoped, and undoubtedly represents the main work on the hanging-wall lead. A winze at 45 degrees from the face has been sunk at 30 degrees down the dip of a 4- to 5-foot band of barite; this winze is reported to have followed the barite down for 88 feet; water, however, prevented the examination of the winze and associated workings. Four short crosscuts, mostly caved, connect this drift with the main portion of the drift, now caved, which is 25 to 30 feet north-eastward and is on the hanging-wall lead.

At 170 feet from the portal a drift, as indicated on old plans, has been driven north-westward for about 300 feet from the main adit; this drift was inaccessible.

At 160 feet from the portal a drift has been driven eastward for 55 feet, the accessible portion, 30 feet, being along a barite-band, presumably the foot-wall band, which here averages 6 feet in thickness. From this drift a winze and a raise, No. 1 raise, have been driven on the barite from a point 20 feet easterly along the drift from the main adit; 10 feet farther along, a crosscut has been driven 60 feet north-eastward across crumpled schists. The winze was inaccessible.

No. 1 raise has been driven on barite for its full length, 100 feet, on a 30-degree slope to the surface, two small stopes, and a branching level lead from this stope, the most significant working, being the level, 40 feet up the raise. At the face of the south-west branch of this level, 50 feet from the raise, and the same distance in the longer north-east but partly-caved branch, an important fault, dipping steeply westward and striking north 45 degrees east, cuts the barite-band. As indicated by the foot-wall barite occurrences westward, the western portions of this band must have been displaced approximately 40 feet south-westward by the fault. This same fault outcrops on the surface between the entrance to No. 3 raise and the portal of the Apex adit.

In the raise and associated workings the barite varies in width from 4 feet to a maximum width of 15 feet.

The rock formation in this adit is grey, lustrous quartz-sericite schist, in which fissility is so well developed that caving occurs in unsupported ground.

The Apex adit is 80 feet north-westward from and 72 feet above the main adit. It has been driven north 28 degrees east for 37 feet, north 19 degrees west for 45 feet, and north 42 degrees west for 32 feet. South-east from the portal and 5 feet across the regional dip a 1-foot band of barite occurs, and at the portal two 18-inch bands separated by 18 inches of schist, and 30 feet in from the portal two bands of barite separated by 1 foot of schist—namely, a 2-inch band and another which varies from 3 feet to 18 inches; all the barite-bands strike north 45 degrees west and dip 30 degrees north-easterly. The adit is lagged from 30 feet in, to the face, and stoping is reported to have been done in the hanging-wall lead both above and below the adit. Specimens from the wall along that portion of adit striking north-west consist of barite and sulphides that are typical of material from the hanging-wall lead. For 50 feet from the face a broken quartz-lens, averaging 1 foot in thickness, strikes north-west and dips gently north-easterly across the schist. The rock formation is grey schist.

The upper adit is 75 feet above and 125 feet in a direction north 20 degrees west from the Apex. Only 50 feet of this working was accessible; in this distance the adit has been driven southward from the portal, and at 38 feet in encounters a 4-foot band of barite, which strikes north 50 degrees west and dips 30 degrees north-east. The rock formation is a talc-sericite schist.

The uppermost working of all is a 12-foot adit, 73 feet above and 80 feet in a direction north 63 degrees west from the previously described adit. This is in barite and is at the base of the Barite Bluff, which exposes a 31-foot thickness of grey barite. As seen in this working, the lower contact of the barite is against a quartz-lens which cuts the schist up to the barite and then spreads along the base of the barite-band; the upper contact is indefinite, consisting of bands of barite decreasing in number and in thickness. This thick band of barite does not continue for more than 35 feet along the strike.

Numerous irregular and lenticular areas of quartz occur on the surface and in the workings. These are mostly conformable, but do crosscut the schists occasionally; however, they do not cut the barite, but lens out either below or above a barite-band. The quartz is usually barren, but in places carries pyrite. Frequently, however, the adjacent schists have become silicified. Such lenses occur in the short adit below the Barite Bluff; in the Apex adit; in a bluff between the surface entry to No. 1 raise and the portal of the main adit, and at several places in the main adit. The quartz in the bluff consists of lenses of watery quartz up to 2 feet in thickness and separated by thin layers of schist; the strike-length of these lenses is not greater than 20 feet. In the adit the largest occurrence is a 4-foot interbedded mass of barren quartz 75 feet from the portal. These lenses of quartz do not appear to be of economic interest.

Numerous outcroppings of barite-bands occur in the shallow draw, which extends northward up the hill and a few feet west from the portal of the adits. These occur discontinuously north-westward from the portal of the Apex adit for approximately 75 feet and consist of two sets of bands, 15 feet apart across the dip; the bands are up to 1 foot in thickness and 15 feet long, and probably represent a continuation of the foot-wall band as found in the Apex adit.

In addition to the main fault that strikes north-east and has displaced the ground to the north-west of it for a maximum estimated amount of 40 feet horizontally to the south-west, there are numerous other faults of lesser magnitude which cut and displace both quartz-lenses

and barite, but the displacements have not been so great or indeterminant that continuations of the leads have not been found beyond them.

North Star (Birk Creek).

The *North Star* group comprises the following mineral claims: *Lydia, Creede, Reno, Petrus, Thelma Fraction, Faros Number 1,* and the *Lark.* These claims were variously staked in 1924, 1933, and 1934 by the present owners, Nick Forsberg, Oscar Bolin, Carl E. Johnston, and associates, *of Barriere. The property is reached by 8 miles of good pack-horse trail up Birk Creek from* Carl E. Johnston's ranch at the end of the North Barriere Lake Road; this ranch is 20 miles north-east from Barriere, a settlement on the North Thompson River some 40 miles north of Kamloops.

The claims lie to the south-west of the headwaters of Birk Creek and at elevations ranging from 4,500 to 5,500 feet. The workings, as of June, 1936, comprise a south and a north group. The south group is the more extensive and consists of two short adits and several open-cuts, which have been driven on showings in the steep, easterly-facing slopes of Creede Creek, the uppermost south-west tributary of Birk Creek. The north group of workings, at an elevation of 4,500 feet, is some 4,000 feet north-west from the south and in the low-lying area at the head of Birk Creek; these open-cuts, which have been driven into the bank of Birk Creek, are badly sloughed and only surface exposures could be examined.

The rock-types constitute a conformable, slightly metamorphosed series consisting of lustrous phyllite, flaggy, cherty quartzite, pebble conglomerate, a highly-altered feldspar-porphyry dyke, and two carbonate rocks, both conformable to the other rocks, but one consisting of ankeritic carbonate and sericite and the other only of calcite, the former probably representing the carbonization of some previous rock and the latter merely recrystallized limestone.

These rocks strike north 20 degrees west and range in dip from 50 degrees north-east to vertical. An ideal section north-eastward across the dip and along the hillside on the level of the upper adit would show by actual exposures and by projection of beds along their strike to the section-line the following approximate thicknesses: Ankeritic carbonate zone, 20 feet; grey cherty quartzite, 30 feet; phyllite, 20 feet; pebble conglomerate, 15 feet; impure quartzite and phyllite zone, 40 feet.

The phyllite varies from a sandy shale with well-developed secondary cleavage to a black, wavy phyllite, the cleavage surfaces of which are made lustrous by abundant sericite. The quartzite is variable. A flaggy phase consists of ribs of light, greenish-grey or of black, cherty quartzite, the ribs ranging from 3 to 4 inches in thickness and alternating with shaly layers which range from ¼ to ½ inch in thickness. A more massive phase consists of a dark-grey, coarse aggregate of watery quartz-grains accompanied by a few feldspar and hornblende grains. Stresses on this rock have been sufficient to develop a periphery of fine-grained quartz around the larger grains of quartz, but not to impart any marked lineal structures to the rock.

The fine pebble conglomerate to coarse grit contains both smooth and angular pebbles, oriented with the strike of the main rock-mass, and ranging in size from ¼ by ⅛ inch to 1/16 by ⅛ inch. The pebbles represent dense, light-grey feldspathic and black cherty rock-types and are set in a fine-grained quartzitic matrix spotted by aggregates of replacing ankeritic-carbonate grains. The ferruginous carbonate-zone occurs both in the south and north workings. It is seen to consist of alternating patches of carbonate and densely-packed sericite fibres that replace the carbonate and are evidently a manifestation of hydrothermal action. A few large, irregular quartz-grains are also present. The limestone occurs in a few scattered points between the north and south workings; unlike the ferruginous carbonate-zone, the limestone does not weather brown but to a dark-greyish mass of granular calcite.

Medium-grained and highly-altered diorite outcrops north-westward up the creek from the showings of the north-group; it is in contact with the ferruginous limestone.

Quartz-sulphide bodies occur as irregular lenses and as more or less tabular veins cutting the various members of the above metamorphic series. The sulphides in the veins are chiefly galena and sphalerite; occasional bunches of pyrite and small amounts of chalcopyrite occur, but no tetrahedrite was seen. Ankeritic carbonate, earlier in formation than the quartz veins, is widespread in the rock formations and usually occurs as small scattered patches of rusty-weathering grains. Gold values are low, but silver, lead, and zinc values are comparatively high.

South Showings.—These showings have received the greater amount of prospecting and therefore will be described in some detail.

The workings may be divided into three generalized groups—(1) a western, disclosing a tabular vein which strikes north-south in flaggy, grey, cherty quartzite; (2) a central group, showing disconnected quartz-lenses in sheared phyllites and black quartzites; and (3) an eastern group, exploring a roughly tabular quartz vein in phyllites, impure quartzite, and conglomerate.

(1.) Five open-cuts and strippings beginning to the west of and continuing south from the upper adit have exposed a tabular quartz vein, presumably continuous from the first exposure, beginning at a place 30 feet south-west from this adit and extending southwards a distance of approximately 150 feet on a 30-degree hillside sloping up towards the south. The vein strikes north, dips from 45 degrees to 50 degrees west, and varies from 4 inches to 2 feet in width, but the change is gradual. The vein cuts flaggy quartzite that strikes north 30 degrees west and dips approximately vertical. The vein-matter is mostly quartz, but small pockets of galena and pyrite occasionally occur.

(2.) Several open-cuts and one adit, the upper, have been driven on the various disconnected lenses of quartz comprising the central group, the description of which immediately follows.

The most northerly of four cuts has been dug on the west side of the creek at a point 80 feet westerly from the cabin. These four open-cuts have been dug across a northerly-striking zone of irregular quartz-lenses. Ninety feet of strike-length has been partly explored by these cuts. The strike of the different portions of these showings varies from north to 20 degrees east and west of north; the dips are very variable. The widths range from a few inches to 3 feet of quartz. Small segregations of galena occur in the lenses; such material carries the values. A sorted sample taken by the Resident Engineer in 1935 from the second cut southwards assayed: Gold, 0.54 oz.; silver, 40.6 oz.; lead, 62 per cent.; zinc, trace.

The showings in that portion of the second group lying on the east side of the creek have been explored by one large open-cut, the upper adit, and by intermediate strippings. The open-cut is 140 feet south-east from the cabin; the adit is 120 feet south from this cut and 100 feet higher in elevation. The open-cut has been driven for 25 feet along a narrow zone, 4 to 5 feet wide, consisting of black, sheared phyllite that lies between two zones of flaggy, cherty quartzite, striking north 20 degrees west and dipping 50 degrees north-easterly; black quartzite lies on the east and a light-grey variety on the west of the sheared phyllite. The face of this cut shows three irregular and connected quartz-lenses in the sheared phyllite; the maximum width of any portion is 10 inches; sulphides are scarce.

Between the 25-foot cut and the upper adit (the position of these has been given in the foregoing paragraph) there are four irregular areas of milky quartz; they contain very little sulphides. The largest lens measures 15 feet across an irregular width.

The upper adit, 245 feet in a direction south 15 degrees east from the cabin, begins as a deep open-cut driven south 32 degrees east for 36 feet, then as an adit at south 18 degrees east for 26 feet and south 40 degrees west for 21 feet. Six feet from the face a 6-inch tabular quartz vein containing patches of pyrite strikes north-south across the adit and dips 50 degrees east. Four feet farther from the face, quartz-lenses carrying similar sulphides occur; on the east wall there being a group of 10-inch lenses and on the west wall 3 feet of lenticular quartz. From 10 feet outside the portal to a point 15 feet in, there is a vein that is variable in strike and dip but continuous; 10 feet outside the portal it begins at a place 4 feet and 2 feet from the floor in the east and the west walls respectively, and 15 feet in it disappears in the floor as a vein, striking north-west and dipping 20 degrees south-west; here it carries abundant sulphides, and a sample taken across a 24-inch width by the Resident Engineer in 1935 assayed: Gold, 0.20 oz.; silver, 19.6 oz.; lead, 32 per cent.; zinc, 4 per cent. The rock for 10 feet from the face is grey, flaggy, cherty quartzite, striking north 20 degrees west, dipping 75 degrees north-east in conformable contact with phyllite that extends to the portal and the open-cut.

(3.) The workings on the third or eastern group of showings consist of four surface cuts, and a low-level adit, known as the lower adit, driven to intersect the downward extension of quartz veins exposed in the upper open-cuts; at the time of examination the adit had not encountered any vein-matter. This lower adit is 165 feet in a direction south 58 degrees

east from the cabin; it is also at approximately the same elevation as, and some 75 feet in a direction north 70 degrees east from, the 25-foot open-cut on the east side of the creek and described under group (2). It has been driven south 88 degrees east for 18 feet, south 40 degrees east for 25 feet, and south 7 degrees east for 21 feet. Twenty-five feet from the face it follows a fault-zone approximately 8 inches wide and containing some gouge; the face shows 2 inches of gouge in this fault, which, at the face, strikes north 20 degrees west and dips 60 degrees east. Along the back there are many small drag-folded quartz stringers in the phyllitic wall-rock. It is to be noted that the hanging-wall of the fault in the face is phyllite, whereas the foot-wall is dark impure quartzite, which continues for 20 feet along the west wall of the drift.

At a point 240 feet in a direction south 50 degrees east from the cabin, or 80 feet south 30 degrees east from and 60 feet higher than the portal of the lower adit, a short open-cut has been driven across a shear and on a quartz-sulphide lens that averages 1 foot in width. A 20-inch foot-wall sample taken across this by the Resident Engineer in 1935 assayed: Gold, 0.36 oz.; silver, 40.6 oz.; lead, 52 per cent.; zinc, trace. The rock is sheared phyllite.

Twenty-five feet above and some 15 feet south from the short open-cut last described, trenching has exposed a quartz vein ranging from 1 foot to 2 feet in width that strikes north and dips 50 degrees easterly. The north end of this exposure is bent and dies out in a strong vertical shear-zone striking approximately north 20 degrees west, but the vein continues southwards up the hill to a third cut driven southward for 8 feet. In this cut the vein ranges in width from 12 to 18 inches, and towards the face is drusy and contains a greater amount of galena and pyrite than in the lower cut. It is to be noted that in the lower cut and in the portal of the upper, the vein is in slightly sheared, impure quartzite, but towards the face of the upper it enters a hard massive band of pebble conglomerate that is approximately 15 feet thick.

A band of conglomerate probably the same is exposed 160 feet south and some 50 feet higher in elevation, where a stripping 30 feet long exposes a quartz vein which strikes north and dips 55 degrees east; this vein attains a maximum width of 1 foot, becoming lenticular when it passes from massive conglomerate and impure quartzite into sheared phases of these and of phyllitic rocks. The continuity of this vein or its possible connection with that exposed in the three lower cuts has not been proved by work along its strike. It is to be noted that the only intrusive on these north showings occurs 25 feet west of the last-mentioned showing. Here an 8-foot feldspar-porphyry dyke strikes west for an exposed distance of 40 feet through impure quartzites, and has been so thoroughly carbonatized by ankeritic carbonate that the surface outcrop is a brown earthy mass.

North Showings.—The north showings are some 4,000 feet north-west from the south group and are in the upper stretches of Birk Creek at an altitude of approximately 4,500 feet.

The two workings on these showings consist of a combined open-cut and adit in south bank of Birk Creek, and a second open-cut some 150 feet westerly up the creek; these have been driven from the creek-level southward into a cut-bank that is approximately 30 feet high. Since no recent work had been done, the adit was caved and the open-cuts badly sloughed at the time of the examination.

The first, or easterly showing, consists of several sinuous quartz veins that range from 1 to 12 inches wide and occur in highly sheared phyllite and phyllitic conglomerate.

The sheared phyllitic rock is in conformable contact on the west, with a massive red weathering and highly ferruginous carbonate-zone which strikes north 30 degrees west and dips approximately vertical.

The sulphides in the quartz veins consist of abundant sphalerite and galena, with minor amounts of pyrite and chalcopyrite; no tetrahedrite was seen.

A section of rock approximately 40 feet long by 10 feet high has been exposed by the sloughing of this old open-cut and short drift (reported length 10 feet); the latter was apparently driven on the strongest of the quartz veins described above, although the face is reported to contain material similar to some dump material which was seen to be a granular quartzose rock made blotchy by scattered patches of galena, sphalerite, and ankeritic carbonate; this rock appears to represent incipient replacement of the impure quartzite by sulphides and ankeritic carbonate.

The second or westerly showing, approximately 150 feet north-westward up the creek from the first, consists of one open-cut approximately 10 feet in diameter. Here a section of pyritized quartzite lying in the foot-wall and east of some massive ferruginous limestone is cut by a shear-zone 2 to 3 feet wide; the shear contains numerous 1- to 4-inch stringers of quartz; mineralization is slight. The shearing is conformable to the general attitude of the rock, which strikes north 20 degrees west and is approximately vertical in dip. It is to be noted that this showing is westward from the easterly showing and is across the strike of the formation.

No ore had been shipped at the time of examination.

Twin Mountain. This group consists of six mineral claims, *Twin Mountain Nos. 1* to *6*, inclusive, staked in December, 1936, and owned by Henry Height and associates, of Barriere. The camp, at an elevation of 4,500 feet, and the workings, at an elevation of 5,000 feet, are on the west side of Adams Lake, the elevation of which is 1,360 feet. They may be reached from Samatosum (Johnston) Creek, which is 6 miles up Adams Lake from Agate (Squaam) Bay, by a steep pack-horse trail about 5 miles long. The cabin is on a heavily-wooded, low plateau, but the showings are on a steep and also heavily-wooded hillside which slopes south-westward to the plateau; they are some 500 feet above the cabin.

The workings consist of twelve trenches and strippings across a dolomite-zone that averages 10 feet in width and is enclosed in rocks which vary from quartz-sericite to greenstone schist. This zone strikes north-west and has been traced by the cross-trenches for approximately 4,600 feet. Inasmuch as the showings in these trenches are all very similar, they will not be described in detail.

The dolomite-zone consists of a main layer, ranging from 9 to 20 feet in width, that is accompanied by other thinner layers spaced a few feet on either side of the main one and which range in width from 10 inches to 10 feet; all the layers are separated by beds of schist, with which they are usually conformable. Where the zone is not conformable, however, it is seen that the schist is bent in the direction of the dolomite layer, indicating that in such instances the dolomite occupies a fault, movement along which bent and dragged the schist in the direction indicated.

The schists strike north 45 degrees west and dip 50 degrees north-east. Frequently the dolomite is cut by quartz-lenses which are quite discontinuous, pinching out within a few feet, and which range in thickness from an inch up to 3 feet. The dolomite itself is by no means pure, but is an intimate mixture of quartz, dolomite, and sulphides. Both the dolomite and the quartz contain varying amounts of galena, sphalerite, pyrite, and chalcopyrite. Several samples across the mineralized zone were taken, and these are enumerated below:—

Gold.	Silver.	Lead.	Zinc.	Nature of Sample.
Oz. per Ton.	Oz. per Ton.	Per Cent.	Per Cent.	
0.50	0.8	0.84	3.7	Across 2 feet of heavily mineralized dolomite.
0.02	5.0	36.50	3.5	Picked, heavy galena specimens.
Trace	3.0	18.90	.....	Across 6 inches oxidized dolomite, but showing considerable galena.
0.02	2.0	14.00	.....	Selected heavy sulphides from contact of schist and dolomite.
Trace	Trace			Heavy pyrite in a quartz-lens.

The rock formations consist of a gradational series of schists that strike north 45 degrees west and dip 50 degrees north-easterly. In the immediate vicinity of the dolomite they vary from buff-coloured, paper schist—i.e., quartz-sericite schist—to a mottled, light-green phase—i.e., one containing small amounts of chlorite. In the bluffs, which lie 25 to 100 feet to the north-east, greenstone-schist occurs; this is quite green and chloritic and frequently more massive than the quartz-sericite schist. It is to be noted that the greenstone is conspicuously cut by many veinlets of dolomite.

Adams Plateau Area.*

Adams Plateau.—This plateau extends between Adams Lake on the west and the North Fork of Scotch Creek on the east, a distance of some 12 miles from east to west. The plateau

* By J. S. Stevenson.

proper is at an elevation of 6,000 feet, is approximately 7 miles in diameter, and equidistant between Adams Lake and Scotch Creek.

The writer wishes to state clearly that the names applied to the various groups of workings described in this report are the names under which such groups have been described in the Annual Report of the Minister of Mines for previous years, and that they are also the names by which such groups are locally known. Because of the lapsing of claims and of restaking during this summer (1936), the present ownership, grouping, and new naming of claims has not been officially ascertained for this report.

On the plateau and close to its rim there are four properties, or rather groups of claims—the *Lucky Coon* (McGillivray group), the *King Tut*, the *Speedwell* (Thornton-McLeod) group, and the *Mosquito King* (Bischoff group).

The first three are near the headwaters of Spillman Creek and are reached from Adams Lake; they were examined by the writer. The fourth is reached from Scotch Creek and was not examined. The average elevation of these groups is 6,000 feet. Between the first three, which are on the north-westerly edge of the plateau, and Adams Lake, there are two other groups—the *Donnamore* (Lund) group at an elevation of approximately 4,500 feet and the *Della* group at an elevation of approximately 3,500 feet.

With the exception of the *Mosquito King* group, the above-mentioned properties are reached from Adams Lake. A motor-road goes from Squilax, which is 41 miles east of Kamloops on the Revelstoke Highway, to the south end of Adams Lake, 9 miles distant. From here three routes may be followed—the best is by a good pack-horse trail which begins at the south end of Adams Lake, approaches the plateau from the south side, following a route which lies west of Nikwikwaia (Gold) Creek, climbing steeply for 5½ miles to 6,000 feet elevation, that of Adams Lake being 1,360 feet, and then along the top of the plateau northward for 5½ miles to the properties, which are near the headwaters of the main West Fork of Spillman Creek. The second route is by motor-boat for 18 miles up the lake to Spillman Creek and thence south-easterly by a steep foot-trail (McLeod's trail) for 6 miles to the properties. The third route is by way of a very steep trail (Wilson's trail) from a point on the east shore 13 miles from the south end of the lake. This reaches the plateau and the properties within a distance of approximately 4 miles.

The outcrop of the mineralized zone on the main plateau groups (*Lucky Coon* and *King Tut*) extends north-eastward along the rim of the plateau at an average elevation of 6,000 feet. On the west and north-west the badly-burned hillside slopes steeply, 20 degrees to 40 degrees, towards Adams Lake. On the east and south-east the country is gently rolling and is of a typically alpine, open-grazing type, with interspersed meadows and thickets of scrub spruce and balsam.

With the exception of the *Della* (described in the Annual Report of the Minister of Mines for 1934), which is a small showing of silver-bearing grey copper, all these properties are lead-zinc prospects. The oldest groups and those on which most work has been done are the *Lucky Coon* (McGillivray) and *King Tut* groups.

These properties were first described in the Annual Report of the Minister of Mines for 1927. At that time three main exposures were known on the *Lucky Coon*—namely, the main *Lucky Coon* showing to the north-east, the showing in Spillman Creek, 4,000 feet to the south-west on the then *Elsie* claim, and an intermediate one in a small creek on the then *Golden Eagle* claim. Apparently at that time very little work had been done. In 1928 the Granby Consolidated Mining, Smelting, and Power Company optioned the *Lucky Coon* group and did 694 feet of diamond-drilling, 3,420 feet of trenching, and 52 feet of drifting (Annual Report of the Minister of Mines for 1928, page 210), then relinquished the option. From the 1930 Report it is inferred that the Granby Company drilled six holes. A small amount of further prospecting was done in 1929 by H. McGillivray (one of the original stakers) and associates.

Since 1930 no new work of importance has been done on the *Lucky Coon* group. One thousand feet of surface work is reported to have been done in 1932 on the *King Tut* group and stripping and the driving of short workings done on the *Speedwell* and *Donnamore* groups to the north-west. Many of the claims have lapsed and were restaked this summer (1936), so the exact ownership is not known. However, the names used are those under which the properties have been previously described in the Annual Reports of the Minister of Mines.

References to the Adams Plateau area may be found in the Annual Reports of the Minister of Mines for the years 1927 to 1932, inclusive, and for 1934.

Lucky Coon (McGillivray) Group.

The mineralization consists of narrow, slightly lenticular, layers of sulphides and silicified rock, and represents the replacement of limy, quartz-sericite schists, phyllites, and greenstone-schists, by mineralizing solutions. That which has been considered as possible ore is a narrow layer, in places two layers, ranging from 20 inches to 4 inches in width and averaging approximately 10 inches, that extends from the main *Lucky Coon* showing on the north-east to the *Elsie* showing in Spillman Creek, a distance of approximately 4,000 feet. Typical specimens of the sulphides were polished and studied under the metallographic microscope.

Except where extremely massive, the ore is definitely banded. The sulphides include arsenopyrite, pyrite, sphalerite, galena, and argentite and a little tetrahedrite in a very siliceous gangue. The proportions of the sulphides to one another, or to the gangue, vary considerably along the strike of any one bed.

Arsenopyrite, ranging from 1 to 25 per cent. of the sulphides, occurs as well-crystallized, diamond-shaped grains ranging from 1 millimetre to 0.5 millimetre in diameter, or as smaller grains averaging 0.02 millimetre, the smaller grains representing larger ones which have been nearly replaced by sphalerite or galena.

Pyrite, ranging from 1 to 75 per cent. of the sulphides, occurs characteristically as cubes that may be embayed or largely replaced by sphalerite or galena, but which are markedly unbroken by fracturing. This indicates that there has been little or no stress on the pyrite since its formation. The large cubes average 1 millimetre in size, but smaller areas average 0.05 millimetre. Many of the larger cubes are by no means solid pyrite, but may contain up to 25 per cent. of small, cusp-shaped areas of replacing sphalerite and galena.

The sphalerite and galena are commonly intimately intergrown; the galena replacing the sphalerite in such a manner that embayed islands of sphalerite with intricate cusp-shaped borders to the galena prevail. A study of sphalerite-galena areas, free from other sulphides or gangue, indicates that the galena may contain up to 40 per cent. sphalerite, an average size-distribution of sphalerite areas being 5 per cent. 0.07 mm., 85 per cent. 0.035 mm., and 10 per cent. 0.007 mm. Areas of single sulphides greater than 0.07 mm. in size are not common. In addition to sphalerite, a field of galena may contain numerous islands of arsenopyrite, pyrite, and gangue of similar size and shape, the aggregate amount of these exceeding that of the galena.

Argentite occurs only in the galena and as small irregular areas averaging 50 microns in size; it is not common and can only be seen by careful etching of a galena surface.

The rock formations affected by the sulphide mineralization include quartz-sericite schist, greenstone-schist, and phyllite, all somewhat limy, ranging in strike from north 50 to 60 degrees east and in dip from 30 to 50 degrees north-westerly; however, a large area of quartzite is found in the vicinity of Nikwikwaia Lakes, lying 1¼ miles south-westerly from the Elsie adit in Spillman Creek and approximately half a mile south-east from the projected strike of the above rocks. The quartz-sericite schist is light grey in colour and so well foliated that the weathering of outcrops gives rise to an abundance of fine flake-talus; under the microscope the schist is seen to consist of wide bands of fine-grained quartz containing an abundance of sericite, and of narrower bands of chlorite and well-crystallized calcite. The greenstone-schist grades imperceptibly into the above, the only difference being a marked increase in the chlorite content. The phyllite is a lustrous black rock, the foliation-planes of which are minutely crenulated; microscopically it is seen to consist of broad, wavy layers of cloudy, carbonaceous material and fine-grained quartz and of thinner, lenticular streaks of calcite or of recrystallized quartz; minute fibres of sericite are very widespread. The quartzite is a light, grey weathering rock cut by numerous, sinuous, quartz veinlets. Microscopically the rock consists of a mosaic of clear quartz-grains containing numerous shreds and some lenticular bands of sericite, and cut by veinlets of more coarsely-crystallized quartz.

The following description of the workings will conform as much as possible to descriptions in previous reports:—

Cross-sections of the main band, which were available for sampling on the McGillivray group, were few and only four samples taken. These compare in kind with those reported by

the Department in previous years, and indicate that in proportion to the lead there is a large amount of zinc present and not large amounts of silver.

The most important showing on the McGillivray group is the main *Lucky Coon* showing. Here a cut exposes a length along the dip of 15 feet and a width across the dip of 4 feet. The sulphide-lens as exposed ranges from 10 to 14 inches in thickness and consists of banded galena, pyrite, arsenopyrite, and sphalerite in a siliceous gangue; the latter constitutes about 10 per cent. of the vein-matter. A sample taken across 14 inches assayed: Gold, 0.02 oz. per ton; silver, 3.4 oz. per ton; copper, *nil;* lead, 3 per cent.; zinc, 16 per cent.; and arsenic, trace.

Immediately adjacent to this cut on the south-west the hillside (a dip-slope) has been stripped in two sections, one 100 feet long and the other 65 feet long; both having a maximum slope-width of approximately 25 feet. These strippings show that there is one, and sometimes two, lenses of ore; a hanging-wall lens attaining a maximum width of 8 inches and a foot-wall lens of 20 inches. A thin parting of schist separates them. Several large blocks of slide-rock lie in this stripping. These blocks average 5 feet square, 1 to 2 feet in thickness, and contain widths of ore comparable to that mentioned; it is evident from their orientation that these slabs have moved only a few feet from their outcrop. A sample taken across the full width of the mineralization—namely, 12 inches—in one of these slabs assayed: Gold, 0.02 oz. per ton; silver, 17 oz. per ton; lead, 14.5 per cent.; zinc, 24 per cent.; arsenic, 1.5 per cent. The rock formation in the vicinity is a well-oxidized quartz-sericite schist.

One hundred feet south-west from this stripping a small trench shows a 3-foot section across schist which contains a 1- to 4-inch band of pyrite, arsenopyrite, and a small amount (approximately 1 per cent.) of galena in a very quartzose gangue.

Seven hundred feet south-west from the last a diagonal stripping south-westward up the hill for 120 feet exposes a 1-foot lens of sulphides and quartz; heavy galena occasionally is as wide as 3 inches.

One hundred and fifty feet south-west from the top of this there is a shallow, caved, inclined shaft on a 10-inch lens of rusty schist, containing a few small kidneys of galena.

One hundred and fifty feet south-west from the incline another diagonal stripping south-west up the hill for 120 feet exposes 10 inches of quartz and mixed sulphides, arsenopyrite being abundant.

The next showing is 800 feet to the south-west in a gulch. Here a short section, 10 inches wide, of sulphides, chiefly sphalerite, lies in lustrous black phyllites; some beds are limy. Very little work has been done here.

The last main showing is an adit referred to as the Elsie adit, driven for 25 feet north-east into the bank of the main westerly branch of Spillman Creek. This is a drift along two bands of heavy galena, 6 inches and 14 inches in width and separated by a 6-inch parting of black phyllite. This is by far the best section of galena on the property. A composite sample across these two bands and omitting the rock-parting assayed: Gold, 0.02 oz. per ton; silver, 14.8 oz. per ton; lead, 22 per cent.; zinc, 16 per cent.; arsenic, trace.

A sample was taken across the continuation of the adit-band across the creek and represents a 12-inch section containing three 2- to 3-inch lenses of mineralization similar to that in the adit; this sample assayed: Gold, 0.02 oz. per ton; silver, 10.2 oz. per ton; copper, *nil;* lead, 17 per cent.; zinc, 32 per cent.; arsenic, trace.

Just above the cap of the adit there is a large lens of barren white quartz that is 4 feet thick and extends 10 feet down the dip of the phyllites; it is apparently a discontinuous body.

In the vicinity of the Elsie adit, Spillman Creek affords the best cross-section of the rocks available. To the north-west of the creek adit—i.e., in the north-west section—the rocks are exposed for 400 feet down the creek and are black, lustrous phyllites, with no sulphide lenses. To the south-east the foot-wall section is exposed for 1,000 feet up the creek; here the rocks are chiefly greenstone-schists, which for the last 200 feet on the south-east contain a few intercalated limestone-bands. Other than one 3-foot indefinite lens of pyritic replacement, no sulphide-lenses similar to the main one were seen in this section.

Although Spillman Creek affords the only section across the strike of the prospected band of mineralization, it seems hardly possible that this section would have been so placed as to miss all possible other lenses in the foot-wall or hanging-wall of the main band. It is probable, therefore, that in this vicinity there are no other lenses or bands of galena-sulphide mineralization.

No heavy galena has been found south-west of the Spillman Creek adit. Several open-cuts have been dug at intervals for a distance of 1,400 feet to the south-west, but these are across three very quartzose bands of sulphides, which consist chiefly of pyrite and arsenopyrite; although galena does occur in small amounts. Although the average width of these bands is 1 foot, a pit in the most north-westerly group shows 5 feet of strong silicification with accompanying arsenopyrite, a little pyrite and galena. A 5-foot sample across this assayed: Gold, 0.04 oz. per ton; silver, 3.4 oz. per ton; copper, *nil;* lead, 2 per cent.; zinc, 10 per cent; arsenic, 2.5 per cent.

King Tut Group. The showings are on the old Thornton-McLeod property, the *King Tut*, and adjoins the McGillivray property, *Lucky Coon* group, on the north and east. The workings consist of two short adits, one of which is completely caved, and strippings. The accessible adit is 225 feet north-east from the caved adit and is 3,000 feet north-east from the main *Lucky Coon* showing, first described. At present there are no showings in the 3,000 feet between the *King Tut* and *Lucky Coon*. The open adit is driven north 50 degrees west across sericite-schists and 15 feet from the portal it cuts a 1½-foot siliceous band, which contains a little pyrite, galena, and sphalerite.

Five hundred feet eastward across a meadow two strippings, each 25 feet long and 25 feet apart, expose a hard siliceous rib, 2 to 2½ feet wide. This is chiefly quartz but contains small amounts of mixed sulphides, pyrite, arsenopyrite, galena, and sphalerite. A short 2- to 3-inch lens of a fine-grained mixture of galena and sphalerite was seen.

Approximately 1,000 feet north-east from here several trenches have been dug, but these have all sloughed and no work was evident in any of them. Judging from the sparsity of mineral samples on the dumps, nothing of importance was found in these trenches.

Speedwell Group. These workings are on a bench on the steep hillside about 6,000 feet in elevation. They are below and 1 mile north 40 degrees east from the *King Tut* adits. The mineralization is by no means similar to that in the *Lucky Coon* or *King Tut* workings. Two short adits, one caved and the other locked, have been driven on decomposed rusty schist and phyllite that evidently originally contained abundant pyrite as the only important sulphide. The rock formations include quartzose-schist and phyllite in the immediate vicinity of the workings and 200 feet north of them steep bluffs of monzonite.

Donnamore (Lund) Group. The workings on this property are on a steep hillside sloping into one of the eastern branches of Spillman Creek. They lie between 4,500 and 5,000 feet elevation and are approximately 3 miles north 35 degrees east from the *Lucky Coon* showings. At present the property may be reached by either of two ways—by a steep foot-trail, approximately 4½ miles long, and a climb of 3,200 feet from the eastern shore of Adams Lake at the mouth of Spillman Creek; or by a steeper trail descending 1,500 feet for approximately 1½ miles from the *King Tut* showings.

The workings examined are very definitely off the plateau. The strippings show a predominant series of laminated argillaceous-quartzite rocks, silicified in varying degrees, and containing a very strongly silicified band, 6 inches to 2 feet wide, the latter including occasional concentrations of pyrite, galena, and sphalerite.

A sample across 2 feet of this material assayed: Gold, 0.02 oz. per ton; silver, 1.6 oz. per ton; lead, *nil;* zinc, 22 per cent.; arsenic, trace.

Lincoln Property. This is on the east side of Adams Lake, some 3 miles south of Squaam Bay. Although it is not on the plateau, mention is made of it here to indicate that the mineralization is not a continuation of that found on the plateau. The occurrence is a relatively clean 18-inch replacement-band of pyrite and some quartz in grey quartz-sericite schists which strike north 45 degrees west and dip 45 degrees north-east. The average strike of the schists, etc., on the plateau is north 50 degrees east and the dip north 50 degrees west. The work done on this property consists only of one short adit and three to four small strippings; they are all at lake-level.

PLACER DEPOSITS.

Harris Creek.

Harris Creek flows into the broad Lumby-Long Lake Valley at a point 3½ miles south-west of Lumby. The creek heads in the Buck Hills and flows north-west some 14 miles to its con-

fluence with Nicklen Creek, and from this point, north and east to Shuswap River, the combined stream is known as Bessette Creek. To avoid confusion the latter name is not used in this report. From a point 13 miles east of Vernon, on the Vernon–Edgewood Highway, the creek is reached by a side-road 2½ miles in length.

The elevation of the lower section of Harris Creek is about 2,000 feet and that of the near-by summits is 3,500 feet and more. Below the principal tributary, McAuley (Gold) Creek, and for 2 miles above, a total distance of 7½ miles, the creek flows in a flat-bottomed valley with steep sides, the average width of valley-bottom being commonly 600 to 700 feet and in a few places 300 to 400 feet; the grade is about 80 feet per mile. Immediately below the mouth of Nicklen Creek is a section of canyon about 100 feet wide and 600 feet long, from which the creek enters upon the broad Lumby Valley. A prominent gravel-bench level flanks the Lumby Valley at a height of 200 feet and is preserved in sections in at least the lower 6 miles of Harris Creek Valley. Timber is heavy in the creek-bottom and on the south side of the valley, the north side of which is openly wooded.

Geology.—The rocks of the region are principally schists and gneisses of considerable age. At the mouth of the creek mica-schist is the common rock-type, and above the mouth a grey-coloured, gneissose dioritic rock is plentiful. Abundant boulders of a dark-grey lava in the stream-gravels point to the presence of Tertiary lavas near the headwaters. Little is known of the distribution of these rocks, or of the precise age and character, beyond the fact that the pre-Tertiary rocks form a complex assemblage of highly altered sedimentary and volcanic materials intruded by one or more ages of granitic rocks. A few quartz veins are known, and these undoubtedly have contributed some gold.

The creek-gravels are composed of resistant, gneissose, and granitic materials and a high proportion of grey lava; boulders in excess of 2 feet are rare. Bed-rock is possibly not deeply covered, but, although there is no direct evidence, there is probably at least 20 feet of gravels in the valley-bottom. The high-level gravel benches are imperfectly exposed and so cannot be well studied, but it is certain that they are stream-deposited, and remnants 220 feet above the creek some 3 miles from the canyon show that the valley was at one time filled with gravels to that level.

At the mouth of Nicklen Creek, Harris Creek has forsaken its former outlet, now gravel-filled, to swing sharply west and then sharply north again in the short canyon already referred to. In this canyon on the west side is a gravel-filled bed-rock channel, the lowest point in which is some 20 feet above Harris Creek. This channel, it is believed, trends westerly. Some 300 feet south-easterly, on the opposite side of the creek, is a rock-rim which is apparently a remnant of the same channel less than 100 feet in length. This is a part of the pre-Glacial drainage of the ancestral Harris Creek. A section of what is undoubtedly the same drainage system has been shown to exist at two points, 3¾ and 4½ miles up-stream, on the south-west side of and about 20 feet above the creek. These sections show only the outer rim, and that imperfectly, but indicate that possibly 2 miles of an old channel exists, buried to a depth of 100 to 200 feet, with gravels of probably mixed origin. Another section, on the north-east side of the creek and about half a mile above the canyon, is perhaps indicated, but is not proved. Short sections may exist elsewhere, but it is more likely that the channel has been eroded away. The final course of the channel is not known, except that a highly suggestive gravel-filled depression crosses Jones (Duteau) Creek to the west; farther west nothing is known.

The gravel in this old channel is completely different from that in the present stream and from that in the high benches. It is composed of brownish poorly-sorted materials, frequently in sharply-angular fragments of local derivation; i.e., composed largely of schists and gneisses of the same character as the bed-rock. Unlike the gravels of Harris and other streams, there is practically no Tertiary lava, "young-looking" granite, or quartzitic rocks, and only very occasional small fragments of quartz are to be found. Some pebbles and boulders have undoubtedly travelled far, but for the most part the gravels appear local in origin. Bed-rock, in the few small places it has been exposed, is quite strongly weathered, as is practically all of the gravel. Many of the pebbles may be carved with a knife, a few can be crushed between the fingers, and the larger boulders can be demolished with pick and bar. Large boulders and blocks are common, 4 or more feet across, and one has been encountered 14 feet long. The gravel is stratified, and there is some evidence of shingling, but it is poorly sorted and "dirty"; small pockets of yellow clay are rather common, particularly about the

larger boulders. Many fragments, of all sizes down to the smallest, are sharply angular, and this fact, coupled with the poor sorting and character of materials, points to a rapid accumulation of local detritus in probably a swift-flowing and steep-walled stream. In these gravels is found heavy, well-worn gold of a character rarely found in the bed of Harris and never in the tributary creeks. The gold is all coarse, in nuggets to 1¾ oz. weight, is dark in colour, and is thoroughly polished; it very occasionally contains included quartz, but no quartz has been found adhering to the gold. There is extremely little black sand. In Harris and tributary creeks is found (in small quantities) fine, light-yellow gold, frequently rough and with adhering quartz, and with which is associated considerable black sand. This latter gold is believed to be of local derivation.

No glacial deposits are to be seen in the bottom of Harris Creek Valley, and on the valley-walls timber-cover and detritus are sufficiently thick in most places to mask the character of the unconsolidated materials. Boulder-clay has been exposed in the hydraulic pit on the west side of Harris Creek Canyon, and definitely overlies the gravel within the old channel. The thickness of this boulder-clay is not yet known, but the base is at a lower elevation than much of the gravels at one time built up by Harris Creek. On Jones Creek, in a shaft not seen by the writer, glacial material is reported beneath several feet of surface gravels; this latter site is below the one-time level of Jones Creek.

The geological history may be summed up as follows: In pre-Glacial times there existed a narrow canyon stream that followed essentially the same course as the present Harris Creek and then swung west towards Long Lake. With the advent of Glacial times this canyon became choked with detrital materials washed down from the adjacent hillsides. Later still the region became covered with ice which filled the choked valley. The valley at this time or later was overdeepened and considerable parts of the former bed were destroyed; this overdeepening extended to a depth of about 50 feet or perhaps greater. The ice tongue or glacier flowed straight through towards Lumby, and the westerly-flowing section of old channel became completely filled with glacial deposits. Following recession of the ice, Harris Creek built up its bed with gravels to a depth of 220 feet or so, and still later, when less heavily loaded and with a general falling in level, cut down through the valley-fill. At this time it forsook the glacial outlet into the major valley and cut a short canyon through and across the older channel, which remained choked with detritus and covered by boulder-clay.

Whatever the origin of Jones Creek, great quantities of gravel were brought down by this creek from a steep canyon-like valley, and were built up as a delta that nearly obliterated the major valley at this point and reversed the course of at least part of the drainage in that valley. More recently Jones Creek has incised this delta at the north-east margin and has cut a canyon across what appears to be the rock rim of the ancestral Harris Creek.

Placer-mining.—Small quantities of gold were found many years ago in the bed of Harris Creek and of its tributaries, but until recently no more than surface-panning has been done. This gold, with rare exceptions, is light in colour and occurs in fine rough particles, frequently with adhering quartz, and accompanied by considerable black sand. In one or two localities gold in coarser, darker, and more well-worn particles has been found, and this led Paul Johnson and Alf. Brewer first to the belief that a former channel existed, and finally to its discovery, in the summer of 1936, in the canyon of Harris Creek.

Leases have been staked covering the lower 8 miles of Harris Creek, the ground between Harris and Jones Creeks, and a considerable portion of the valley-flat at the mouth of Harris Creek. Test-work has been concentrated in the lower or northern section, but a small amount of testing has also been done for 5 miles up the creek.

In the uppermost working known to the writer, on the south-west side 4½ miles from the mouth of Harris Creek, on a lease belonging to Brewer, Sr., a drift has been driven 10 feet on weathered rim-rock in weathered semiangular gravels. Some gold is reported from the actual rim 20 feet above the creek. On ground three-quarters of a mile down-stream from this locality a very little digging shows a rock-rim and similar gravels, but no real testing has been done. The width and extent of this section of channel are not known, and it is not known whether gold occurs in paying quantities. Other test-holes are scattered along the margin of the creek-bed, none of which are conclusive. Testing in the bed proper has consisted of surface-panning, and no pits have been sunk deeper than a few feet.

The original discovery is on the east side of the creek at the head of the small canyon and just below the mouth of Nicklen Creek. Here Brewer and Johnson report recovery of 12 oz. of coarse gold from amongst large boulders at and near irregular bed-rock over an area some 15 by 50 feet. This remnant of channel is not yet worked out and coarse gold can still be panned. Brewer and Johnson then moved across to the channel exposed in cross-section on the west side of Harris Creek and recovered 14 oz. of gold before optioning the ground to James Armes, of Vancouver.

The lowermost gutter of this channel, 20 feet above the creek, is about 10 feet wide, 20 feet above which the channel is 60 feet wide with steeply-flaring walls. Gravels as exposed are about 45 feet deep, above which is boulder-clay to an exposed thickness of 25 feet, and total cover, not all exposed, reaches a maximum depth of 160 feet at a point some 500 feet west of Harris Creek where the ground slopes gradually towards Jones Creek. A lens of clean-washed, rounded, and some angular gravel partly separates the dirty angular gravel from overlying boulder-clay. Gold has been recovered in a pay-streak 10 feet to 25 feet above the lowest gutter and to a lesser extent in the uppermost 15 feet of rather cleaner and smaller-sized gravel; bed-rock has not been followed at any time. A monitor, fed by an 8-inch pipe from a centrifugal pump run by a 65-horse-power motor, has made an excavation in the centre of the channel totalling about 1,000 cubic yards. Water has been insufficient to handle economically the boulder-clay, which has had to be blasted down. Water rights were secured on Nicklen Creek and a dam built at the mouth of Nicklen Lake to store 2,000 acre-feet of water; it has been estimated that with half a mile of ditch and flume 15 cubic feet of water per second can be delivered at a head of about 300 feet. Late in 1936 James Armes's interest was bought out by Mrs. Duncan Smith. This group comprises eight leases.

On Jones Creek, 1½ miles west, ground is being investigated by means of a shaft under the direction of O. D. Frith, of Vancouver, who has optioned ground in that vicinity. The position of the old channel here is not proved, but is strongly suggested by a prominent east-west rock-rim through which Jones Creek has cut a canyon; immediately south of this rim are gravels. As Jones Creek at this point and Harris Creek Canyon are at practically the same elevation the channel would necessarily be 100 or more feet deep. At the end of 1936 a shaft was put down 15 feet, at which point boulder-clay was encountered beneath (Jones) creek-gravels.

At the mouth of Harris Creek, on the valley-flat, several leases are staked and some test-pitting has been done with a view to proving dredging-ground. Six or more pits were sunk, in some of which interesting values have been reported, but only one, on the edge of the valley, was put down to bed-rock. The ground here is flat, and Harris Creek has obviously swept back and forth over a considerable area, planing down the gravel valley-fill and leaving faint evidence of former low gravel banks. In this locality, at the mouth of the canyon, it is likely that any gold carried by the creek would be dropped, but it is not yet known whether this gold is distributed evenly or in streaks, and the depth to bed-rock in the main valley is not known.

The whole area adjoins a ranching district in which water is a valuable commodity, and any operation involving treatment of a considerable volume of gravel must be prepared to dispose of tailings and guard against diversion of water used for irrigation. This need not, however, be a serious handicap to placer-mining. Actual gold-recovery has so far been from a restricted locality, and considerable testing is in order before any final estimate can be made of location and continuity of "pay."

Winfield (Wood Lake).

Gold-bearing gravels have been found high up on the eastern hillside flanking Wood Lake. These gravels are at an elevation of about 3,000 feet and are known to extend from near Clark Creek north for a distance of about 2 miles. In the southern part of this section, near Clark Creek, sparsely-wooded ground slopes gently, but is irregularly broken by small dry ravines and short steep rises; bed-rock outcrops are not plentiful. In the central and northern parts the gravels are found on a wooded slope cut by a few small gullies which are dry for all but a brief period in spring; 100 or more feet below is the steeper Wood Lake valley-side. Immediately above are bluffs of basalt which rise in steps to plateau ground on the east 200 to 500 feet higher. The gravels are to some degree water-bearing and occasional springs occur at and near the lower edge of the line of outcrop.

From the small settlement of Winfield, 14 miles north of Kelowna, on the Kelowna–Vernon Highway, a branch road leads to a sawmill camp on Clark Creek, a distance of 4 miles; a rough side-road 1 mile in length from near Clark Creek leads nearly to the chief site of activities, the Hall and Eley leases. From the end of this road a trail follows north along the hillside.

Bed-rock is a grey, commonly porphyritic rock which varies between granite and granodiorite. Unconformably overlying the granite is Tertiary basalt in a number of superimposed flows, 20 to 40 and more feet in thickness. Associated with the basalt are poorly consolidated tuffs which occur beneath the lowermost and between some of the succeeding flows. Considerable of the ground is masked by overburden which is generally referred to as glacial; glacial deposits do exist, particularly at and near the south end of the occurrence of gravels, but exposures are insufficient to allow of accurate determination of character and distribution of these deposits.

The unconsolidated, gold-bearing gravels lie above weathered bed-rock and beneath the lowermost basalt-flow. Consequently, although the precise age of the basalts is not known, the gravels are Tertiary in age. They are definitely stream-lain and represent part of an ancient drainage system. The gravels are strikingly different from any others in the general region; they are very light in colour, are well rounded, and are composed of highly resistant materials. Pebbles up to 4 inches in size are commonest; there is not much sand and few large cobbles, although boulders in excess of 2 feet are occasionally found. The commonest material is a white or nearly white quartzite of fine grain, much of which closely resembles vein-quartz; other materials include granite, syenite, diorite, quartz, obsidian, gneiss. Concentrates from panning contain abundant garnet but very little black sand. The gold is quite pure, of a reddish colour, and is found as flattened pellets of match-head size and smaller. In some localities much of the gold is reported to be very fine and in others it appears that pellets predominate.

Little is definitely known regarding the course and dimensions of the channel. It is very probable that it flowed from north to south, because there is to the north a source for the white quartzite pebbles and none to the south for many miles; differences in elevation must not be relied upon too strongly, because some tilting of the land surface may have taken place in Tertiary times and also because there may be tributaries, as yet unrecognized as such. The base of gravel at the Aitkens and Staples lease on the north is about 200 feet higher than at the Hall and Eley leases. Gravels are found at intervals from near Clark Creek, in an arc round the side-hill, north for 1½ miles, and again at Aitkens and Staples lease, south of which for over half a mile no gravels have been found; it is not known whether in this latter section the channel has been eroded away or remains obscured farther to the east—in any event a fairly sharp bend is indicated. At the south end either the hillside follows closely a bend in the former stream or else the channel is several hundred feet wide. The channel is nowhere exposed in cross-section, so it is not known whether it is simple or complex. The channel has been faulted, roughly parallel to the line of basalt cliffs, and the outer or western segment has dropped down.

The Tertiary channel was undoubtedly covered by basalt-flows. A tunnel driven on the Eley lease below the cliffs definitely proves the existence of gravel beneath basalt. The base of the gravel is here covered by coarse talus, just west of which is a ridge of basalt which is an erosion remnant of the down-dropped fault-segment. Drifting in three places in this locality and also on Aitkens and Staples lease is reported to have started on bed-rock, which dips easterly, then has encountered an upswing 150 to 200 feet in and has ended in blocks of basalt, seemingly dragged down by the faulting, and which lie amongst gravels on or close to bed-rock. The faulting, of less than 100 feet displacement, has apparently been quite extensive and roughly parallels the contour of the hill; open cracks in the basalt are found a few hundred feet back from the line of cliffs on the Summerville lease. At the southern end of the known occurrence of gravels, erosion, and deposition of glacial materials, has obscured the distribution of gravels and the relation of these to bed-rock.

Of the many short drifts, test-pits, and open-cuts erratically distributed throughout the 2 miles of ground, some are in gravels, some in tuff, and some in glacial materials or overburden. Several drifts, 100 to 350 feet in length, have been driven both by individual and company endeavour, and of these only two are now accessible. As detailed descriptions of

workings seen by the writer would be incomplete, none will be attempted, more especially because much of the evidence given by the workings is of doubtful value.

In the fall of 1935 J. A. Brusset, general manager of Western Canadian Collieries, Limited, of Blairmore, Alberta, obtained an option on approximately 1,400 acres of leases. Work, under the direction of D. J. McNeil, included two drifts on the Eley and Hall leases, as well as surficial exploration at scattered points; the option was relinquished June 30th, 1936. In the first drift, 350 feet long on the Eley lease, water-filled at the time of the writer's visit, testing on bed-rock throughout returned disappointingly low values. In the second drift, 170 feet long on the Hall lease and at a height of at least 10 feet above bed-rock, the gold content of the gravels was insignificant. The writer is unaware of results obtained in any of the other workings, and he did no testing.

Both reported recoveries and the clean, open character of the gravels seem to preclude the possibility of gold occurring in paying quantities except at or close to bed-rock; if the channel is a single trough, gold is to be expected within that trough; but, if complex, gold may be concentrated in any one of the several troughs or gutters.

The shallow troughs in bed-rock encountered in the longer drifts on the Hall, Eley, and Aitkens-Staples leases have not been proved to be cross-sections of the actual channel and might conceivably represent a side-channel or channels.

Testing to the south-east has given little definite information and is difficult in view of the amount and variety of unconsolidated materials.

Testing beneath the undisturbed basalt has not been attempted except by one short drift, now caved.

The lack of conclusive information obtained by the already considerable amount of work done indicates that if the channel is to be proved in cross-section and thoroughly tested, a large-scale programme will have to be undertaken. Before underground work is contemplated an accurate contour-map should be made of the entire stretch of ground, showing all geological data in detail; some shallow test-work might then be done to advantage, and finally some point of attack chosen for drifting. There is no site without its drawbacks, but at some place on the Eley lease below the cliffs, in unfaulted ground, a drift would perhaps be able to prove the eastward extent of the gravels. Bed-rock is not exposed here, and 100 feet or more of gravels is indicated. From a drift as low down as it is possible to make a convenient entry shafts would have to be sunk to bed-rock. Such a programme would necessitate considerable capital outlay and would be warranted only if considerable ground was owned or controlled.

There is no basis at present for estimation of position, extent, or value of maximum gold concentration in these gravels. It is to be hoped that prospecting farther afield, to the north, may throw more light on the problem and that some point may be found where the channel may be more easily and cheaply explored in cross-section.

Putnam Creek.

Putnam is a small easterly-flowing creek 12 miles north of Lumby. It heads in a mountainous country and flows in a narrow valley some 5 miles in length to enter the broad, terraced Trinity Valley. The mouth of Putnam Creek Valley is easily reached by automobile from Lumby. The creek traverses a series of deformed and altered sediments among which dark-coloured slaty argillites are prominent. Granitic and dioritic rocks of unknown distribution intrude the sediments, but are not abundant in the lower stretches of the creek. Quartz veins are said to be of common occurrence in the district.

Gold was discovered in October, 1936, by Paul Johnson and Alf. Brewer, and four leases were soon after bonded to Jack Hanna, of Greenwood, and associates. Since then the holdings have been extended by additional staking.

The creek, for 2 miles above the limit of the Trinity Valley terraces, flows in a narrow flat-bottomed and steep-sided valley 100 to 200 feet wide. The grade, as determined by barometer and estimation of distance, is 5 per cent. The sides are of rock, largely masked by slide materials, and one narrow canyon 400 feet long skirts a former blocking of the channel. The surface gravels are composed predominantly of slates of local derivation and cobbles and boulders of gneiss and granite are fairly common. Boulders are occasionally as large as 4 feet, and sizes between 1 and 2 feet are common. There is not, in this lower section, any sign of glacial deposits or of glacial action. Two miles up-stream the valley widens and the bottom

is choked with glacial till and boulder-clay; this material is reported to be common for some considerable distance up the creek.

Bed-rock is not exposed in the 1½ miles below the canyon, but is not likely covered to a depth of more than 15 feet; above the canyon the cover is deeper. Gold is scanty in the surface slaty gravels, but is reported to be more abundant in underlying reddish gravels of schistose and gneissose materials. The gold is heavy, well rounded, and is associated with black sand. From several shallow pits interesting values were reported, but very little testing had been done at the time of the writer's visit and bed-rock had not been reached.

This creek flows in a valley, the lower 2 miles of which do not appear to have been affected by glaciation. Whether or not boulder-clay at one time lay in this lower section is not definitely known, and neither is it known whether the underlying, reddish gravels are pre-Glacial. It is very probable, however, that the gold is of pre-Glacial concentration and not deposited as a result of the reworking of glacially-derived materials.

Scotch Creek.

Scotch Creek flows into the west end of Shuswap Lake and drains more than half of the region lying north of the main body of Shuswap Lake and between Seymour Arm and Adams Lake. North and east branches of equal size unite to form the main creek at a point 9 miles north of Shuswap Lake, and it is in this section of the creek that placer gold has been found. The region is one of marked relief and is heavily timbered. Adams Plateau, on the west, attains an elevation of about 6,000 feet and summits north of the fork reach a maximum elevation of 7,390 feet. Scotch Creek and the lower stretches of the two principal branches occupy old, flaring valleys with steep slopes slightly indented by precipitous tributaries. From an elevation of 1,850 feet at the fork the creek drops 700 feet in the 9 miles to Shuswap Lake.

A good motor-road crosses Little Shuswap River and follows the north shore of the lake as far east as Anglemont. The mouth of Scotch Creek is 8 miles from the bridge. A ferry service is maintained from Sorrento on the south shore to a point 2 miles east of Scotch Creek on the north shore of the lake. No trail exists up the creek from the mouth, but the upper valley is reached by motor-road from Celista to the ranch of C. C. Sturdy, a distance of 6 miles, from which point a forestry trail follows along the steep eastern valley-wall and extends north and west to Adams Lake. The lower 2½ miles of the trail have been widened to allow passage of a narrow-gauge wagon, and a branch half a mile long leads down to the camp of Scotch Creek Placer Mines, Limited, a mile below the fork. Foot-trails lead to other workings in that vicinity.

Topography.—The accompanying sketch-map is prepared from aerial photographs and is not strictly accurate. A short distance above the fork the north branch flows in a narrow canyon, with falls aggregating 100 feet in height; a canyon exists on the other branch about 2 miles north-east of the fork. Below the fork the stream is of a quite uniform gradient and follows a somewhat meandering course; one canyon section 1½ miles below the fork has a minimum width of 50 feet, but elsewhere the stream is 30 to 100 feet wide in a valley-bottom which, at a height of about 30 feet above the stream, is 200 to 800 feet wide.

The valley changes in character at a point opposite and just below Sturdy's ranch. Below, the valley is typical of old streams in the interior of the Province; terraces of stratified gravels occur on both sides of the stream to heights as great as 200 feet, and bed-rock is occasionally seen on either side beneath the gravels or forming part of the valley-wall. Low gravel flats 10 to 30 feet above stream-level are not extensive. Above the delta, half a mile and more above the road crossing, bed-rock is occasionally seen in the stream-bed, and it is not likely that the gravels in the channel are in any place more than 20 to 40 feet deep. Above Sturdy's the valley is wider; the creek follows close to the east wall and the western half or three-quarters of the valley is occupied by a prominent bench 1,000 to over 2,000 feet wide and 300 to nearly 400 feet above the creek. In this upper section the creek flows close to bed-rock, which is locally exposed, and, except for local low flats, bed-rock outcrops almost continuously on the east side of the creek and the valley-wall rises steeply towards the summits. On the west side of the creek the valley-bottom is bounded by steeply-rising banks composed for the most part of stratified gravels. From the fork to a short distance below the canyon bed-rock is frequently seen on the west side to elevations as great as 200 feet above the creek, but not

as high as the gravel bench; bed-rock is next seen on the west side opposite and half a mile above Sturdy's ranch. Bed-rock is nowhere seen on the bench proper, which rises very gradually on the west to the well-defined, rocky valley-wall. In the lower section of the bench there are no transverse streams—the lateral drainage becomes lost in gravels. Above the canyon small streams show bed-rock only near Scotch Creek, and there appears, in this section at least, to be a rock-rim flanking Scotch Creek on the west.

There is evidence, therefore, that in the upper section of the valley a channel buried deeply by gravels exists parallel to the present creek. The outlet of this channel appears to be opposite and below Sturdy's ranch, at the constriction in the larger valley. The bottom of the channel is probably not much higher, if at all, than that of the present creek, and could not conceivably be more than a few tens of feet lower. The upper end may join the north branch as indicated on the accompanying map where a suggestive depression exists on the hillside; whether or not this was only a temporary channel of the north branch is not known. The relation of the east branch to the buried channel is not known.

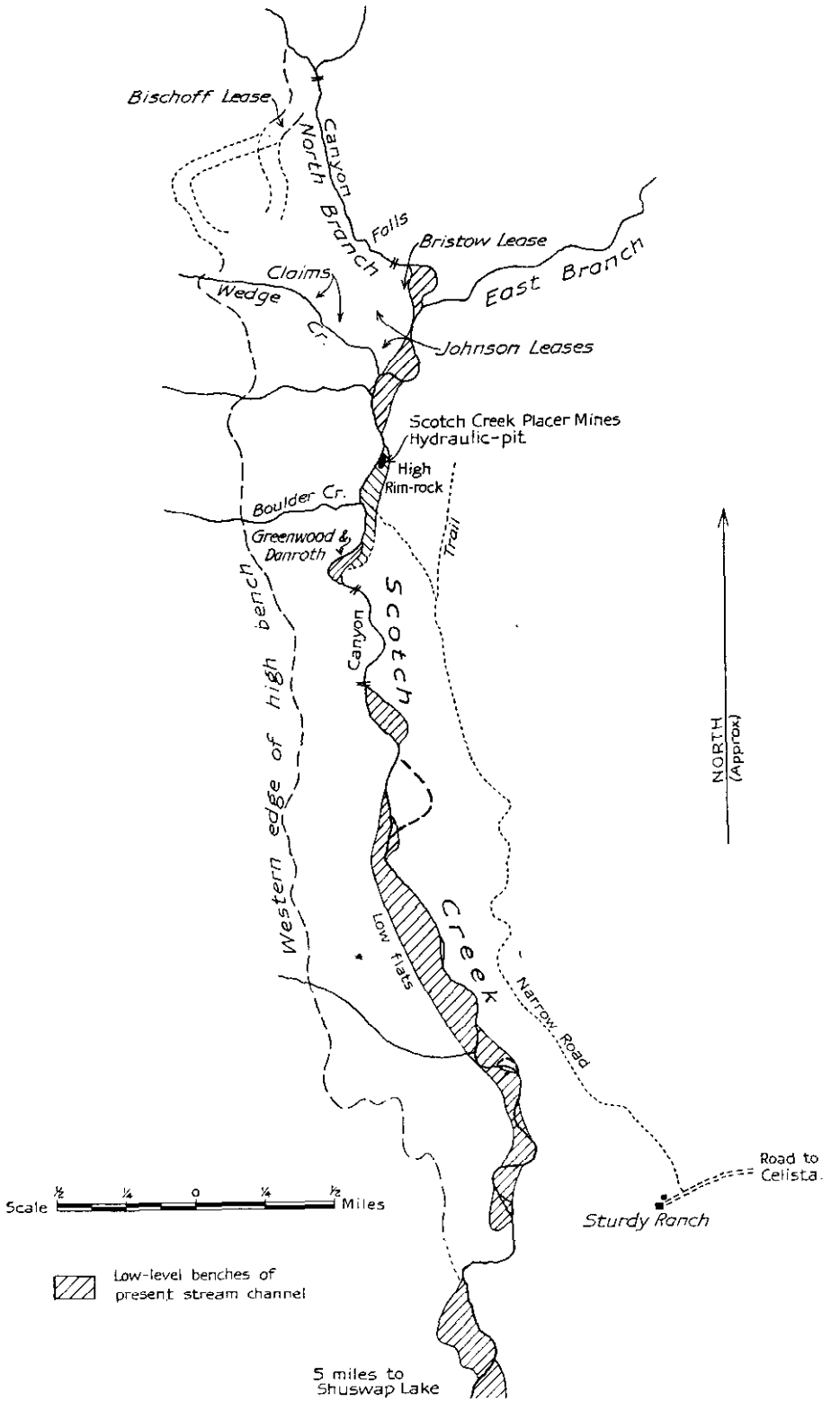
One high rock-rim is known on the east side of the valley, a quarter to three-quarters of a mile above the canyon and 100 feet above the creek. Elsewhere on the east the rocky valley-wall appears to rise unbroken from the valley-bottom.

Geology.—The rocks of Scotch Creek Valley consist predominantly of schists. Greenstone is prominent at the lower end of the valley, north of which calcareous, argillaceous, and less often chloritic and sandy schists dip northerly from a few degrees to 45 degrees. A prominent band of limestone outcrops half a mile due north of the fork and is reported to be found in the canyon of the east branch. A dense, acidic, gneissose rock forms the western valley-wall 1 to 2 miles below the fork. A prominent body of coarse pink granite occurs just north-west of the fork, and the greater resistance of this rock as compared with schists is responsible for the falls on the north branch and must also have been responsible for falls on the upper end of the postulated buried channel.

Scotch Creek has steep, flaring walls, relatively straight and little eroded by transverse streams, rising from an incised valley-fill in which the present stream follows a meandering course. In the lower 5½ miles of the valley the stream swings from wall to wall, but in the upper section the eastern wall is followed closely throughout, and the western half of the major valley is occupied by a high-level bench. All of the bench-gravels are stratified, stream-lain, and very free from clay; lenses and beds of sand are minor in amount. The geological history of the valley is not simple and is difficult to decipher. The country has been glaciated and changes in level have occurred both before and after glaciation. In the upper section of the valley, although a cross-section of the larger bench is in no place seen, it appears that sections of the present stream-channel existed as parts of a former broad valley-bottom of considerable irregularity and probable complexity of channels. This valley was filled deeply with stream-lain gravels at a time when erosive power was heightened, and later still the stream cut down through these gravels, locally cutting new bed-rock channel and also exposing pre-existing channels.

The gold is fairly coarse, is well-rounded and flattened, and is 860 fine. The maximum size of nugget is ½ oz., but nuggets worth more than $2 are rare; adhering quartz is occasionally present. The source of this gold is undoubtedly quite local and is to be found in quartz veins and stringers which are reported to be fairly abundant in this area. No appreciable quantity of gold has been found in the main body of stratified gravels, nor is likely to be found in such thick accumulations of clean, open gravels except for local concentrations in more or less random pay-streaks. The sections worked are those at and near bed-rock where it is more than likely there has been more than one period of concentration in the long history of the valley.

History.—Placer gold was recovered from Scotch Creek many years ago and the creek abandoned in 1877 (Geological Survey of Canada, Report of Progress, 1877–78). Although there is no authentic record, it is probable that prospecting started in the early sixties. Reference is made to the creek in the Annual Reports of the Minister of Mines as far back as 1885, and in the three years 1886 to 1888 $27,000 is reported to have been recovered. Brief mention is then made in the Annual Reports for 1896, 1897, and 1898, from which it appears that in those years a few Chinese were the sole workers. From the last date until recent years little or no work has been done.



Upper Scotch Creek. Sketch-plan showing Location of Properties.

The earlier work seems to have been concentrated in the upper 3 miles of the creek, and the most intensive digging was done immediately below the fork and both above and below the short canyon 1½ miles below. Traces of this work still remaining on flats a few feet to 60 feet above the creek show evidence of the painstaking clean-up operations typical of Chinese miners. Recent revival of activity dates from 1933, when some coarse gold was recovered from benches and the greater part of the creek was staked. Recovery during the past four seasons is not known, but appears to have amounted to several thousand dollars at most. Operations in 1936 included work by one company and a number of individuals.

Bischoff Lease. This lease is on the north branch, 1 mile above the fork, and near the head of the canyon. A small amount of work has been done by hand 100 feet above the creek on the west side, on what may be the rim of the former channel of the north branch; the channel-rims appear to be about 200 feet high immediately above the pit. This pit is in clean, coarse gravel, including rough blocks 6 feet across that rest on an irregular bottom of pink granite. Recovery is not known.

Bristow Lease. This lease is on the west side of the fork where there is a low bench some 20 feet above the creek and which is covered by no great depth of gravel. The owner has built a short flume from a small stream, with the water from which he intends washing the low bench, and possibly also one or more higher steps 200 to 300 feet from, and less than 100 feet above, the creek. Practically no testing has been done.

Johnson (2) Leases. This ground extends from the mouth of Wedge Creek, behind Bristow's lease, to the canyon on the north branch. A little hand-work has been done on Wedge Creek near the mouth, in material that has been reworked by that stream. Recovery has been low.

Hough *et al.* (9) Claims. In 1936 seven men staked claims on Wedge Creek above Johnson's ground and prepared winter quarters. Old-timers worked the bed-rock section of this creek for a distance of some 800 feet from Scotch Creek, at which point the bed-rock is lost to view. It is the intention to sink west of this rock-rim and to investigate, if possible, what appears to be a buried channel.

Greenwood (2) Leases and Danroth Claim. These men hold ground above the canyon and are working co-operatively on a rock-rim within a bend on the east side of the creek. A projecting spur of dark calcareous slates and schists 80 feet or so above the creek has an embayed rim filled with clean, stratified gravels to a depth of 40 feet, and may represent merely a swirl in a former channel of the creek. Water is flumed from a small creek on the west side of Scotch Creek and brought across that stream in a 3½-inch pipe under a head of 230 feet. Water is sufficient to supply only one hose at a time, so that two hoses are operated alternately in near-by pits on the adjoining properties. Perhaps 10,000 yards of gravel have been moved, but recovery is not definitely known. Although bed-rock has been imperfectly cleaned, this ground does not appear to be very rich. Gold is found commonly associated with accumulations of boulders one to several feet in size, and work, with the water available, is slow.

Scotch Creek Placer Mines, Ltd. This company, incorporated in 1935, has acquired all remaining ground, with the exception of two leases, between the fork and Indian reserve land at the upper end of Scotch Creek Delta. The ground held does not completely cover the broad bench in the upper section of the valley, parts of which are still open to location. The head office of this company is Bank of Commerce Chambers, 389 Main Street, Winnipeg, Manitoba. V. J. Melsted, of Salmon Arm, is engineer in charge.

In 1935 investigations and some testing were carried out, chiefly in the upper section of the creek, and it was decided to hydraulic a bench half a mile below the fork and extending 2,400 feet south to Greenwood and Danroth ground. The rock-rim of this bench is 100 feet above the creek on the east side. A 1-yard wood-burning drag-line shovel with 60-foot boom was purchased, to be used partly as testing equipment, and was taken up the bed of the creek as far as Boulder Creek by the spring of 1936.

On the high-level rim stratified gravels are up to 100 feet deep over a known width of about 200 feet, although the ground has not been fully explored. Near the northern end a drift 200 feet long at right angles to the rim shows a broad, shallow depression to a maximum depth of 7 feet at 100 feet from the portal. Water is brought over from the west side of Scotch

Creek from the stream above Boulder Creek at 250 feet head in 200 feet of 12-inch, 1,000 feet of 10-inch, and 600 feet of 8-inch pipe. Two hoses were used for sluicing, with insufficient water for best removal of material, on a bank more than 50 feet high, and a few hundred square feet of bed-rock had been exposed by the end of September. It is impossible to estimate the value of gold here present; probably a number of large yardage tests will have to be made before this can be done. It is almost certain that values will be largely restricted to the vicinity of bed-rock. What work has been done indicates that some good values have been found on bed-rock on the extreme outer edge of the rim, and that values tend to decrease inward.

There has been no systematic test-work on the remainder of the holdings. A few pits have been sunk in the valley-bottom a quarter to half a mile below the fork, but none of these has been put down to bed-rock, and the information furnished by them is inconclusive. In the lower section of the creek, not far above the delta, a little testing was done by the drag-line in its passage up-stream, the results of which are not known. The bed of the creek was scraped for 300 feet at the mouth of Boulder Creek, at a site near where there is evidence of work by old-timers, but results proved disappointing. Late in September it was the intention to move the drag-line up-stream to test the low-lying flats just north of the hydraulic pit.

SPECIAL REPORTS.

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

Marathon.	Highland Valley.	Speculator.
Shamrock.	Jamieson-Lanes Creek Area.	Bounty.
Lost Horse.	Kennellan.	Advance.
Arcan.	Victory.	Silver King-Silver Queen.

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

PROGRESS NOTES.

BY

H. E. MIARD AND JOHN G. BIGGS.

LODE-GOLD DEPOSITS.

North Thompson River Area.

*Windpass Gold Mines, Ltd.**—A. J. Smith, general manager; William Elliot, mine manager. This operation is situated about 5 miles from Boulder, on the Canadian National Railway, and consists of two separate mines known as the *Windpass* and *Sweet Home*, at elevations of 5,300 feet and 4,900 feet respectively and 2,500 feet apart.

The development of the *Windpass* is by means of an adit-level from which, at 400 feet from the portal, a shaft inclined at 35 degrees has been put down 1,000 feet with levels off at 100-foot intervals; from the same point in the main adit a raise was put through to the surface and greatly augmented the ventilation of the mine.

The ore from the *Windpass* is carried over a 2½-mile aerial tram to the mill, which is at an elevation of 1,700 feet; the tram is of the endless design, with track-cable 1-inch in diameter and ⅝-inch-diameter traction-cable, with eighteen ½-ton-capacity buckets in use.

The ore from the *Sweet Home* mine is trucked to the tram. The mill is of 50 tons capacity but is now being increased to 75 tons. The power plant consists of a 400-horse-power Diesel-driven electric installation, situated at the mill, from which power is carried, at 2,300 volts, to the mines. There were sixty-five men employed during the year.

* By John G. Biggs.

Hedley Camp.

*Kelowna Exploration Co., Ltd.**—W. C. Douglass, general manager; Floyd Turner, mine manager. This company operates the *Nickel Plate* mine, situated on Nickel Plate Mountain at an elevation of 5,400 feet and 3,800 feet above the town of Hedley, where the mill is located.

Transportation of ore is by means of 2 miles of electric-trolley motor from the mine to the top of a 10,000-foot surface double-skip 20-degree incline, which delivers the ore to the mill bunkers.

The main slope of the mine is on a 20-degree pitch and is double-tracked, haulage-power being provided by a double-drum electric hoist.

During the year connection was made from one of the lower levels with the adjacent *Hedley Mascot* mine and this greatly augmented the ventilation of both mines.

Development during the year consisted of 2,081 feet of drifting, 900 feet of crosscutting, 717 feet of raising, and 12,160 feet of diamond-drilling. Tonnage mined amounted to 64,594 tons, 64,854 tons were milled, and this yielded 22,613 oz. gold and 2,850 oz. silver.

*Hedley Mascot Gold Mines, Ltd.**—W. R. Lindsay, manager. This mine, situated at an elevation of 4,795 feet on the east side of 20-Mile Creek and 1 mile from Hedley, went into production on the completion of the mill early in the year.

The mill is situated 2,795 feet below the mine, to which it is connected by a Quad-type aerial tram, supported by steel towers, and 5,600 feet in length; the track-cables are 1⅜ inches in diameter and the haulage-cables are ⅞ inch in diameter, with skips of 3-ton capacity.

The mine is developed by an 8- by 8-foot adit driven 2,500 feet to the present ore-body in the vicinity of the *Nickel Plate* mine of the Kelowna Exploration Company, the workings of which have been contacted by the *Hedley Mascot* mine.

Haulage underground is by storage-battery locomotives. Power for underground operations is provided by Bellis and Morcam 2-stage electric-driven compressors having a capacity of 750 cubic feet of free air per minute, with a smaller compressor to augment this when necessary.

Developments during the year consisted of 177 feet of drifting, 59 feet of crosscutting, 1,225 feet of raising, and 1,792 feet of diamond-drilling. Tonnage mined amounted to 30,265 tons; 29,962 tons were milled, and this yielded 13,524 oz. gold and 4,341 oz. silver.

There were sixty-two men employed throughout the year.

Olalla Area.

*Gold Valley Mining Co., Ltd.**—John Pearson, manager. This mine is situated at Olalla and consists of two adit-tunnels driven some 400 feet at 200 feet difference in elevation; an aerial tram 2,100 feet long connects the mine with ore-bunkers near the Keremeos–Penticton Highway; a small amount of ore was shipped to the Trail smelter. Power is supplied by a portable Sullivan compressor.

Five men were employed and general conditions were found to be satisfactory.

Twin Lakes Area.

*Gold Standard (Fairview) Mining Co.**—Joseph Wukelich, manager. This company operated on the Twin Lake property, situated 24 miles south-west of Penticton and at an elevation of 4,700 feet. The ore is transported by truck from the mine bunkers to the 40-ton mill on the property. Ten men were employed.

Fairview Camp.

*Fairview Amalgamated Gold Mines, Ltd.**—J. A. McKenzie, manager. During the year the *Morning Star* and *Fairview* mines were amalgamated to facilitate the operation of both properties.

The *Morning Star* mine is situated 4 miles west of Oliver at an elevation of 2,000 feet, while the *Fairview* mine is 6,000 feet west of the *Morning Star* and at an elevation of 3,080 feet; the ore from the *Fairview* mine is trucked over 2 miles of road to the 75-ton-capacity mill at the *Morning Star* mine.

* By John G. Biggs.

Development in the *Fairview* is by means of a 2,500-foot adit, from which raises are being driven on ore-chutes to the surface; this, when completed, will greatly augment the ventilation, which is now maintained by means of an electrically-driven fan, ventilation-pipes, and air-jets which deliver 700 cubic feet of air per minute to the face; power for underground operations is supplied by a 750-foot Gardner Denver compressor driven by a 150-horse-power motor.

The *Morning Star* is an adit and shaft operation; all the work during the year was done above the 100-foot level, the lower workings being used as a water-storage for the mill operation.

Development during the year consisted of 150 feet of drifting; 12,960 tons of ore were mined, and this yielded 1,511 oz. gold and 21,334 oz. silver.

Osoyoos Lake Area.

*Osoyoos Mines, Ltd.**—J. O. Howells, manager. The mine is situated near the International Boundary in the Osoyoos District, and consists of the reopening of former workings and new developments on the *Dividend*, *Manx*, and *Lake View* claims, which provide the ore for the 50-ton mill on the property.

Power has been provided by Diesel motor, but it is expected, at an early date, to change over to electrical power from the new transmission-lines of the West Kootenay Power Company.

Carmi Area.

Carmi.—R. Legiest and two associates shipped 55 tons of ore from this property to the Trail smelter, the metal contents being 28 oz. gold and 241 oz. silver.

Rock Creek Area.

Imperial.—A shipment of 33 tons of ore made from this property by D. M. McKay, of Grand Forks, yielded 2 oz. gold, 192 oz. silver, 885 lb. lead, and 1,415 lb. zinc.

Kettle River Area.

In addition, lessees worked for short periods on the *Mogul* and the *Little Joe*, small shipments of ore to the Trail smelter being made in each case.

Greenwood-Phoenix Area.

Brooklyn.—Owned by the Brooklyn-Stemwinder Gold Mines, Limited. Head Office, 678 Howe Street, Vancouver. A group of four lessees worked on the property throughout the summer. A considerable amount of preliminary repair-work was necessary before mining operations of any kind could be attempted.

Granby (Old Ironsides).—Operated on lease by W. E. McArthur, of Greenwood, who began operations there in the month of September. Eighteen men were employed (three underground), including the mill crew. The present operations are very near the surface and of the glory-hole type. The ore is brought by trucks to the *Providence* mill, about 5 miles from the mine. The tonnage mined was 4,438; the total metal contents being 511 oz. gold, 1,255 oz. silver, and 153,250 lb. copper.

Bay.—Lessees working on this property shipped 35 tons of ore, yielding 136 oz. gold and 24 oz. silver. Three men were employed.

Athelstan.—This property had been abandoned for twenty-three years when W. E. McArthur began operations there in the late summer. Three men were employed in exploratory and development work. The ore is transported by trucks to the *Providence* mill. The tonnage mined was 603, yielding 373 oz. gold and 292 oz. silver.

Rainbow Group.—Operations of an exploratory nature were conducted on this property for several months, with a crew of ten under the direction of Chas. C. Walker, by the Greenbridge Gold Mines, Limited.

Number Seven.—Situated near Boundary Falls and owned by the Consolidated Mining and Smelting Company of Canada, Limited. During the first half of the year the lessee, W. E.

* By John G. Biggs.

McArthur, employed seven men on the property and shipped a total of 1,039 tons, with metal contents of 192 oz. gold, 5,707 oz. silver, and 18,225 lb. lead.

Dynamo.—Robert Forshaw, of Greenwood, shipped 8 tons of ore from this property, with a total metal contents of 10 oz. gold and 11 oz. silver.

Jewel Lake Area.

Dentonia.—Owned and operated by the Dentonia Mines, Limited. Head office, 706 Credit Foncier Building, Vancouver. Manager, Major A. W. Davis. The development-work undertaken during the year not having disclosed the presence of any further body of workable ore, all underground operations were suspended in November, but the newly-erected cyanide plant continued to treat the tailings from the flotation-mill. The number of men employed passed gradually from seventy (forty-two underground) at the beginning of the year to twenty-three (thirteen underground) at the time of the last inspection. The tonnage mined was 11,612, from which 568 tons of concentrates were obtained, these yielding 4,178 oz. gold, 27,638 oz. silver, and 67,647 lb. lead.

Amandy.—The shipments from this property, on which four lessees were working for some time, amounted to 96 tons of dry ore and 9 tons of concentrates, yielding a total of 30 oz. gold and 448 oz. silver.

Grand Forks Area.

Yankee Boy.—Situated on Hardy Mountain, about 4½ miles from Grand Forks. Owned by the Riegel Mines, Limited. Manager, D. M. McKay. The property was operated by lessees until the beginning of October, when operations were suspended for an indefinite period. The development-work done during the year consisted of 390 feet of drifting, 80 feet of raising, and 50 feet of sinking. The tonnage milled was 389; this yielding 460 oz. gold and 382 oz. silver. The largest number of men employed in the period of operation was nine.

Franklin Camp.

Union.—Owned and operated by the Union Mining and Milling Company of Wallace, Idaho. Operations during the summer months were practically limited to the treatment of 20,174 tons of tailings, from which 103 tons of concentrates yielding 601 oz. gold, 17,904 oz. silver, 686 lb. lead, and 10,261 lb. zinc were obtained.

SILVER-LEAD DEPOSITS.

Beaverdell Camp.

Highland Bell.—The *Bell* and *Highland Lass* mines passed under a single ownership at the beginning of the year through the amalgamation of the two operating companies, the new organization taking the name of Highland Bell, Limited. The headquarters of the new company are at Penticton. N. M. Mattson, who had directed the operations at both mines, remains as manager. The small veins, of high-grade silver-lead ore, are intersected and displaced by numerous faults in the vicinity of which the ground is often "blocky" and somewhat treacherous. Natural ventilation is favoured by the general disposition of the workings, but, on the other hand, it is somewhat hampered by the small dimensions of some of the openings. The method of mining followed is overhand stoping with waste-filling, there being an abundance of stowing material at all times. The number of men employed varied between thirty-two and thirty-eight (from twenty-four to thirty underground). The development-work done during the year consisted of 300 feet of drifting, 140 feet of raising, and 120 feet of sinking. The total production of both mines, before and after the amalgamation, amounted to 3,274 tons, which yielded 120 oz. gold, 501,415 oz. silver, 346,548 lb. lead, and 489,935 lb. zinc.

Sally.—Operated by the Sally Mines, Limited. H. B. Morley, secretary, Penticton. Exploratory work in the older workings during the early part of the year failed to reveal the presence of any ore-shoots of workable dimensions and grade. The number of men employed was eighteen (ten or eleven underground), with John A. Hanna as manager, until the month of July, after which operations were conducted on a very reduced scale, with a crew of only four, under the direction of N. M. Mattson. It is intended to attempt further prospecting of the section of the property adjoining the *Wellington* claim, from the 500-foot shaft, which has

been idle for a number of months. Seventy-four tons of ore shipped to the Trail smelter yielded 3 oz. gold, 5,532 oz. silver, 4,101 lb. lead; and 5,660 lb. zinc.

Beaverdell-Wellington.—Operated by the Beaverdell-Wellington Syndicate. Manager, Allan J. Morrison. The programme of development now laid out includes the sinking of the winze to the depth of another level and the driving of a hoisting-raise to the surface, which would permit the use of a Diesel-driven hoist and greatly facilitate the handling of the surplus waste. The method of working is overhand stoping with waste-filling. Natural ventilation, properly controlled, gives satisfactory results, for the mine-workings are not only extending over a considerable vertical height, but they are also connected to the foot of the *Sally* shaft, thus enjoying the benefit of a motive column 500 feet high. The number of men employed varied between fourteen and twenty-one (eight and seventeen underground, respectively). The development-work done consisted of 1,012 feet of drifting, 91 feet of sinking, and 342 feet of raising. The tonnage mined and shipped amounted to 701, this yielding 37 oz. gold, 151,230 oz. silver, 110,987 lb. lead, and 161,798 lb. zinc.

Tiger.—J. L. Nordman and partner shipped 30 tons of ore from the property with a total metal content of 3,484 oz. silver, 2,718 lb. lead, and 4,760 lb. zinc.

Beaverdell-Rambler.—Some development-work was done on this property by Yakima interests, under the direction of P. E. Crane, who had charge of the operations during the greater part of the period of activity. A small number of men, varying between four and six, was employed more or less irregularly until the end of the summer. Twenty-three tons of ore shipped to the Trail smelter yielded 3,206 oz. silver, 2,463 lb. lead, and 4,972 lb. zinc.

Other properties in the Beaverdell area on which some exploratory work was done during the year were the *Wallace*, on which three men were employed; the *Advance*, where two men worked for several months; the *Balaklava* and other claims forming the *Crater Lake* group, on which the Crater Lake Mining Company, Limited, employed five men for some time; and the *British*, owned by the newly-organized British Silver and Gold Mines Syndicate, with headquarters at Princeton, who employed three or four men during the greater part of the year; all these operations being on Wallace Mountain. In addition, a second prospect-shaft was sunk on the *Olympic* claim, owned by Louis Clery, of Westbridge.

Greenwood-Phoenix Area.

Silver Cord.—O. Johnson and two associates, of Greenwood, shipped 8 tons of ore from this property to the Trail smelter, the metal contents being 3 oz. gold, 294 oz. silver, 294 lb. lead, and 122 lb. zinc.

Keno.—L. Manzini and two associates shipped 89 tons from this property, this yielding 8 oz. gold, 889 oz. silver, and 2,410 lb. lead.

Skylark.—Small-scale operations carried on by W. E. McArthur with a crew of three on this property resulted in the shipping of 99 tons of ore, yielding a total of 31 oz. gold, 5,705 oz. silver, 4,107 lb. lead, and 4,979 lb. zinc.

Providence.—This property was operated on a small scale by the owner, William Madden, of Greenwood, who shipped from it 26 tons of ore, yielding 11 oz. gold, 2,442 oz. silver, 905 lb. lead, and 1,324 lb. zinc. In November, the Riegel Mines, Limited, took an option on the property and began deepening the shaft, a crew of thirteen being employed, under the direction of D. M. McKay. The work done at the end of the year amounted to 32 feet of sinking. The mill on the property has been bought by W. E. McArthur, who is now operating it.

Lightning Peak Area.

Waterloo.—On this property, situated 43 miles by road from Edgewood, the Waterloo Gold Mines, Limited (with headquarters at Penticton), employed a crew of ten, including an assayer and two diamond-drillers, from July 30th to August 15th, and from the end of September until November 20th, with R. W. Mowat in charge of the work. A raise started from No. 4 level and intended to reach No. 2 had been driven for some distance when operations were discontinued for the winter.

Lightning Peak.—W. A. Calder, of Edgewood, shipped 2 tons of ore from this property. The metal contents were 214 oz. silver, 363 lb. lead, and 228 lb. zinc.

COPPER DEPOSITS.

Princeton Area.

*Red Buck Mine.**—Operated by the Red Buck Mining Company, Limited. Fred F. Foster, manager. This mine is situated on the Hope–Princeton Highway, 13 miles west of Princeton and consists of a 600-foot drift from which some raising has been done; this is a hand-mining operation employing ten men.

PLACER-GOLD DEPOSITS.

Greenwood Area.

Boundary Placers.—The Boundary Placers, Limited, employed a crew comprising for a certain time as many as eighty-five men in the construction of a pipe-line 10,000 feet in length, near Boundary Falls, to supply water for the hydraulicking operations which it is intended to begin in the course of the present year. J. W. Phillips was in charge of the work.

NON-METALLIC DEPOSITS.

*The Gypsum Lime and Alabastine Co. of Canada.**—Alex. Jessiman, manager. Falkland quarries, known as Nos. 1, 2, and 3, are situated 1 mile from the Canadian National Railway at Falkland, and the material from the quarries is transported to bunkers at the railway by an aerial tram. The gypsum is carried by railway to the company's factories, where it is manufactured in various forms of building material; a large part being used for fire-proof finishing and building.

The quarries are worked with a high face and the numerous " slips " in the deposit make it necessary to carry the face at considerable angles to provide for safety of the men. Twenty men were employed.

Christina Lake Area.

Fife Lime Quarry.—Owned and operated by the Consolidated Mining and Smelting Company of Canada, Limited. Eight men, working on contract, were employed from June to October and shipped 15,114 tons of limestone from the property to the Trail smelter. No development-work was done. This is a seasonal operation, the men working at the quarry being employed at Trail during the winter.

* By John G. Biggs.

INDEX.

ILLUSTRATIONS.

VICTORIA, B.C.:
Printed by Charles F. Banfield, Printer to the King's Most Excellent Majesty.
1937.

4,725-237-4740

The Annual Report of the Minister of Mines is now issued in parts as follows:—

Part A.—THE MINING INDUSTRY (STATISTICAL REVIEW). John F. Walker.

Part B.—NORTH-WESTERN MINERAL SURVEY DISTRICT (No. 1). Joseph T. Mandy.

Part C.—NORTH-EASTERN MINERAL SURVEY DISTRICT (No. 2). Douglas Lay.

Part D.—SOUTHERN AND CENTRAL MINERAL SURVEY DISTRICTS (NOS. 3 AND 4). M. S. Hedley.

Part E.—EASTERN MINERAL SURVEY DISTRICT (No. 5). H. Sargent.

Part F.—WESTERN MINERAL SURVEY DISTRICT (No. 6). B. T. O'Grady.

Part G.—INSPECTION OF MINES. James Dickson.

PART E

ANNUAL REPORT

OF THE

MINISTER OF MINES

OF THE PROVINCE OF

BRITISH COLUMBIA

FOR THE

YEAR ENDED 31ST DECEMBER

1936

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:
Printed by CHARLES F. BANFIELD, Printer to the King's Most Excellent Majesty.
1937.

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.*

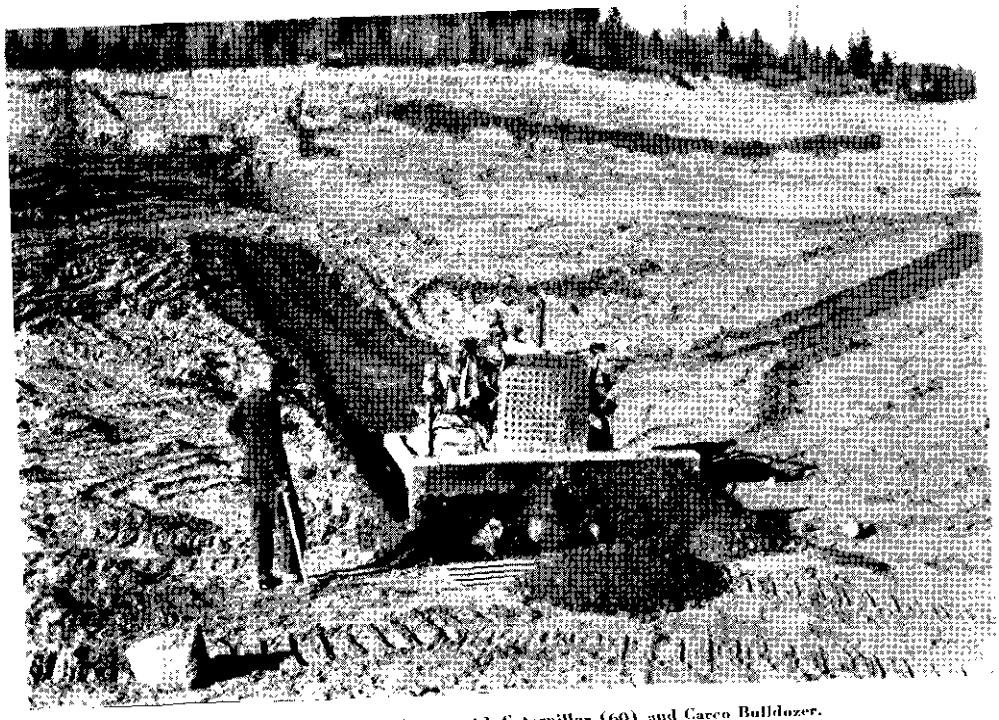
D. E. WHITTAKER, *Provincial Assayer and Analyst.*

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

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

Placer Operation, Palmer Bar Creek, Cranbrook Area.

French Mountain, Head of Bugaboo Creek. From Mercier's Claims.



Sullivan Mine. Filling Stopes with Caterpillar (60) and Carco Bulldozer.

Sullivan Mine. Filling Stopes, Caterpillar (75) with Le Tourneau 12-cu.-yd. Scraper.

PART E.

EASTERN MINERAL SURVEY DISTRICT (No. 5).

BY

H. SARGENT.

INTRODUCTION.

Lode-mining activity in No. 5 Mineral Survey District has been well maintained in 1936. The Slocan-Ainsworth and Lardeau areas in the West Kootenay section have been quiet, but with the increasing prices for lead and zinc much greater activity is to be anticipated in 1937. Though production from the *Sullivan* mine was of record proportions, the rest of the East Kootenay District has been quiet. Production from the Rossland camp, though less than in recent years, was still substantial. In the Nelson Mining Division production reached a new high level, and with the provision of increased milling capacity at the *Kootenay Belle* mine, a new mill for Wesko Mines, Limited, and one for Bayonne Consolidated Gold Mines, Limited, all brought into production late in 1936, a further substantial increase in gold-output is to be anticipated for 1937. Notes on placer-mining appear in a separate bulletin.

The operation of the Bayonne mill is expected to direct interest to the adjoining district, which has prospective merits. In the area underlain by greenstone, south of Nelson, several prospects carrying high gold values, usually over narrow widths, are being opened up. Shears or fissures in the granitic batholith both north and south of the West Arm of Kootenay Lake appear to be attracting interest as gold prospects. Attention is directed to the merits of the above-mentioned sections as prospective gold areas, which in general are outside the areas covered in the following reports on mines and prospects in several parts of the district.

LODE-GOLD DEPOSITS.

NEWER MINES AND PROSPECTS IN THE SALMO MAP-AREA.

The properties described in the following reports are situated in the Nelson Mining Division, in the section which is the subject of "Memoir 172, Geology and Mineral Deposits, Salmo Map-Area," by John F. Walker, published by the Geological Survey of Canada in 1934. For the general geology of the area and for descriptions of most of the properties the reader is referred to the Memoir and its accompanying map.

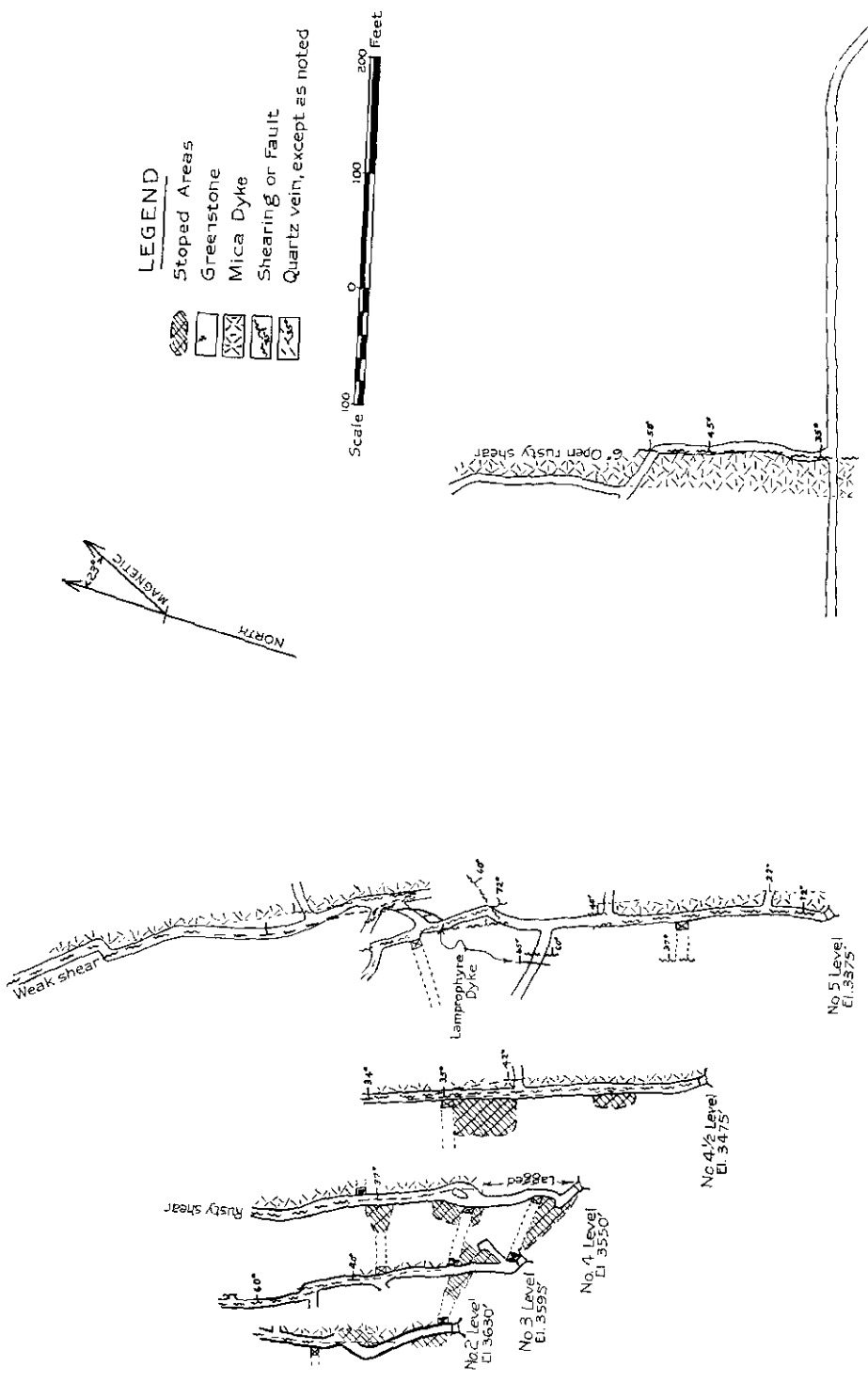
Clubine Comstock Gold Mines, Ltd.

The property consists of nine located claims, formerly known as the *Boulder City* group, held in the name of the Consolidated Mining and Smelting Company, which claims Clubine Comstock Gold Mines, Limited, is acquiring by purchase and an additional eleven located claims. The company, incorporated in the State of Washington, is registered in British Columbia and has an office in Victoria. The claims are situated some 3 miles north of Salmo, west of the Salmo River, on the north-east slope of Keystone Mountain. The location and general geology are shown on Map 299A of the Geological Survey of Canada. The ground held slopes steeply to Boulder Creek. The workings, which extend from approximately 3,125 to 3,630 feet elevation, are situated along Key Creek, a small tributary that enters Boulder Mill Creek from the south-west between one-half and three-quarters of a mile from the confluence of Boulder Mill Creek with the Salmo River. The surface consists of overburden with some rock-outcrops. The country has been burned off generally, but there is some timber toward the top of the mountain.

Leaving the highway about 3 miles north of Salmo, the road crosses a flat for two-tenths of a mile; then, by several switchbacks, in 1½ miles climbs the steep side-hill to the mine camp at about 3,600 feet elevation, roughly 1,000 feet above the flat.

The property is underlain by rocks of the Beaver Mountain-Rossland group, consisting in the vicinity of the workings of some argillite and possibly impure tuff, but principally of greenstone, intruded by lamprophyre dykes which vary materially in composition and texture.

A large mass of Nelson granite east of the property extends to within half a mile of the workings, which are close to a wide brown-mica dyke of greenish-grey colour. Frequently



Clubine-Comstock Mines, Ltd. Plan of Underground Workings from Company's Plan.

along the foot-wall of this dyke there is a width of several feet consisting largely of brown mica. This may be a phase of the wide dyke, but it seems more likely that the dark mica has been developed in shearing along the foot-wall of the wide dyke. Elsewhere in narrower fractures there is dark, basic, porphyritic dyke-matter containing light-greenish phenocrysts. Similar material occurs locally with the dark mica and may be a phase of a dyke at the foot-wall of the wide dyke. The lower contact of the wide dyke strikes about north 20 degrees west and has an average dip of 38 degrees easterly. Shearing, which in general follows the foot-wall of the dyke, is locally confined to a width of 1 or 2 feet, but elsewhere shear-strands extend over widths up to 10 feet in the wide dyke, the brown-mica material at the foot-wall and greenstone in the foot-wall. There is shearing along the hanging-wall of the wide dyke also.

Elongated quartz-lenses have been developed somewhat irregularly in the shears and greenstone in the sheared ground has been silicified locally. The wide dyke has been offset by faulting which may be later than the deposition of the quartz. The quartz-lenses are somewhat irregular in outline and are usually less than 1 foot in thickness, though in places they reach a thickness of 1½ feet. In some parts of the mine there are parallel lenses in the shearing. Two such lenses are being stoped above 4½ level in a width of 5 to 7 feet. The degree of mineralization varies greatly. At some places the quartz is glassy and slightly mineralized; elsewhere it may be heavily mineralized. Some parts of the vein consist of brecciated quartz cemented by chalcopyrite and pyrrhotite. Near by the vein may consist of quartz mineralized with medium-grained galena and fine-grained dark-brown sphalerite. In places brecciated fragments of white quartz are cemented by almost black quartz containing some galena and chalcopyrite. In places sulphides have been developed in the greenstone and dyke rocks close to the quartz. Moderate gold and silver values appear to be associated with the sulphide minerals. Selective mining of unoxidized ore yields a shipping product which in 1936 ranged from 0.65 to 1.4 oz. gold per ton and from 1.5 to 3.4 oz. silver per ton. Earlier shipments consisting largely of oxidized ore were of higher grade. Above No. 4 level the vein-matter is largely oxidized.

The above description applies to the principal workings shown on the plan herewith. No. 1 level, not shown on the plan, is a drift along a shear parallel with, but about 200 feet to the west of, the shear in the principal workings. In No. 1 level the shear follows the contact between a dyke and argillite. Mineralization consists of narrow lenses of lead and zinc sulphides reported to be low in gold. No. 1 level portal is about 330 feet south of No. 2 portal.

The property had been under development for some time prior to 1926, when 300 feet of tunnel and 30 feet of raise on the *Boulder City* claim were recorded by L. R. Clubine, of Salmo. In 1931 work was commenced by the present company under L. R. Clubine. In the years from 1931 to 1934 shipments were made to the smelter at Trail, the ore coming from 2, 3, and 4 levels principally. During this period drifting was done on No. 5 level. In 1935 a new deep level, No 6, was started. After a period of inactivity work was resumed in January, 1936. Drifting and raising have been done on 4½ and 5 levels, while a considerable quantity of ore has been stoped above 4½ level. Late in the year a new level, referred to as the "475 level," was started.

During the year 698 tons of ore containing 740 oz. gold and 1,515 oz. silver were shipped. This ore came from the stope on 4½ level and from development-work. The property is equipped with a compressor, but the stoping and a good deal of the development is done by hand.

No. 2 level has a length of 180 feet. The outer 40 feet has been stoped above the drift and in this section a raise comes through from below. For the next 40 feet the drift is in the foot-wall, but swings to the right and re-enters the vein. At 150 feet from the portal there is a raise. For 60 feet south of the raise the vein has been dug out for a few feet below the level; a pillar separates this work from part of the drift which is in the foot-wall. In this section there is 1½ to 2 feet of rusty shear, containing 2 to 8 inches of quartz and some dark sulphides. North to the face there is less quartz in the shear.

No. 3 level, 270 feet long, is stoped below and partly stoped above for 65 feet from the portal; two raises come through from below in this section and another raise comes through at about 120 feet from the portal. The shearing here is rather tight and the black-mica

dyke is squeezed. At 190 feet from the portal the drift is offset to the west, leaving one shear-strand at the offset to follow another. The foot-wall formation here exposed in the drift appears to be silicified argillite or tuff. There is a little quartz in the shear.

No. 4 level, about 300 feet in length, is lagged and apparently stoped above for most of the first 90 feet from the portal. In the 110 feet beyond there are two raises with some stoping above the drift. At the end of this section is a winze down about 15 feet. From the winze south for a length of 100 feet at or below the floor there is from 6 inches to 1 foot of quartz or quartz breccia.

No. 4½ level also had a length of about 300 feet when the property was last visited. It follows shearing throughout its length. From 75 to 100 feet from the portal a little stoping has been done; here on the hanging-wall of the drift 2 to 6 inches of quartz is to be seen. At 185 feet from the portal is a crosscut to the hanging-wall 20 feet long. In the crosscut 8 inches of well-mineralized quartz goes down into the floor. This is a hanging-wall lens occurring along shearing within black-mica dyke-matter. It is traceable for 80 feet northerly along the drift, the thickness varying from 6 inches to 1 foot. There is also a foot-wall quartz-lens in a shear in greenstone below the dyke. For 60 feet north of the crosscut the ground is being stoped above the level. At the north end of the stope is a raise which was up about 60 feet at the middle of September. At the bottom of the raise the hanging-wall lens is from 6 inches to 1 foot thick and is mineralized with fine pyrite. This lens pinches out about 20 feet up the raise. The foot-wall lens has a thickness of about 4 inches at the bottom, but increases above and is more persistent than the hanging-wall lens. The foot-wall lens, varying in thickness from 4 to 15 inches, is traceable for about 50 feet north and the same distance south of the raise. At the face of the adit, about 75 feet north of the raise, the shear in the greenstone, 3 feet below the dyke, again contains quartz, here 9 inches thick. There is also rusty shearing along the contact.

No. 5 level is the longest drift on the shear-zone. It follows shearing in the greenstone and in the wide dyke close to its lower contact with the greenstone. Crosscuts to the hanging-wall indicate that the width of the dyke varies from 12 to 20 feet. About 125 feet from the portal is a raise or a short stope, up about 40 feet, following about 3 feet of shearing near the contact. Near the hanging-wall at the top of the raise is 6 inches of rusty gouge. At the foot of the raise there is 2 inches of quartz with some sulphides. At 250 feet from the portal there is a 65-foot crosscut to the foot-wall, cutting a basic dyke 9 inches thick, 33 feet from the drift. Under the dyke is 3 inches of shear-gouge with some quartz. The dip of the shearing and of the dyke is 65 degrees to the east. The drift swings to the east at a fault 60 feet past the crosscut. The wide dyke is displaced to the east, north of the faulting; basic dyke-matter occupies fractures curving to the east in the fault-zone. Shearing, however, continues and has been followed about 160 feet past the first faulting, the drift then swinging north-westerly to follow another shearing. About 70 feet past the first faulting is a raise which follows some shearing. The raise was up about 60 feet at the middle of November. At the top the ground is disturbed. Rather glassy white quartz up to 1½ feet thick was apparently faulted. Dyke-matter similar to the dark basic dyke exposed on the level occupied some irregular fissuring.

From a point 10 feet south of the raise a crosscut has been driven 30 feet north-easterly, where it intersected an irregular quartz vein squeezed between fault-strands. The quartz has been followed by drifting to the north and for a short distance to the south. A crosscut from the north drift exposes some of the quartz at a bulge between fault-strands. Over a length of about 30 feet the quartz is very irregular, varying in attitude and in thickness, the latter varying from 8 inches to 3 feet. Here the hanging-wall of the drift is the wide dyke. The drift to the north follows a somewhat irregular course for a distance of about 300 feet from where the quartz was first encountered. For most of this length the drift follows shearing in the greenstone in the foot-wall of the wide dyke. Quartz apparently in the foot-wall north of the crosscut to the north-east is exposed 50 feet from the crosscut. From that point north the shear contains from 2 to 11 inches of quartz for a distance of 100 feet. Thence to a bend in the drift 90 feet farther there is 2 to 11 inches of shear-gouge containing a little quartz. Beyond the bend the shearing followed by the drift is rather weak.

No. 6 level, 250 feet below No. 5, starts close to Key Creek as a crosscut curving from a course north of west to south 70 degrees west at 80 feet and continuing this course to the

face at 540 feet from the portal. Near the portal it crosscuts schistose greenstone, beyond which the greenstone is massive with some shearing. At about 400 feet from the portal shearing along the hanging-wall of a wide, green, mica dyke similar to that found above was encountered. There is also parallel shearing 30 feet to the west near the foot-wall of the dyke. From the crosscut a drift extends 150 feet northerly following the rather open shearing, 6 inches wide, along the hanging-wall, the dip varying from 30 to 50 degrees easterly. Thence a crosscut extends 50 feet westerly and from it a drift for 160 feet curving somewhat west of north, following shearing in the greenstone below the dyke. These shears apparently contain little or no quartz.

Gold Belt Mining Co., Ltd.

Thirteen Crown-granted claims and fractions—*Bluebird, Joint, Shamrock, Dominion, Golden West, Double Joint, Sunbeam Fraction, Bruce Fraction, Columbia, Navada, Peggy, Twilight,* and *Happy Jean*—are owned by the Gold Belt Mining Company, Limited. The company also has under option the six Crown-granted claims of the *Clyde-Belt* group, *Belt, Clyde, Leach Fraction, Cathie Fraction, Lily D.*, and *Bella Watson Fraction.* The company also holds by location the following: *Fraction No. 1, Fractional No. 2, Lilian Fraction, No. 10 Fraction,* and *G.B. Fraction.* The claims lie on both sides of Sheep Creek adjoining the *Golden Belle* group; the holdings of Reno Gold Mines, Limited; the Fawn Mining Company; Kootenay Belle Gold Mines, Limited; and Sheep Creek Gold Mines, Limited. The Gold Belt Mining Company is a public company incorporated in British Columbia, with head office in Vancouver.

The ground south of Sheep Creek, opposite the *Reno* mill, is underlain by quartzite of the Quartzite Range formation, exposed in precipitous bluffs. This ground is essentially undeveloped. North of Sheep Creek the ground held lies down-stream from the *Reno* mill and extends from creek-level at 3,200 feet elevation to an elevation of 6,300 feet on a spur from Reno Mountain over a mile north of the creek. The ground extends from east to west from one-quarter to three-quarters of a mile and from the creek north for a little over 1½ miles. The slope of the ground is commonly steep and outcrops are frequent. However, toward the crest of the ridge and on the Nugget (Fawn) Creek slope there is a considerable depth of overburden.

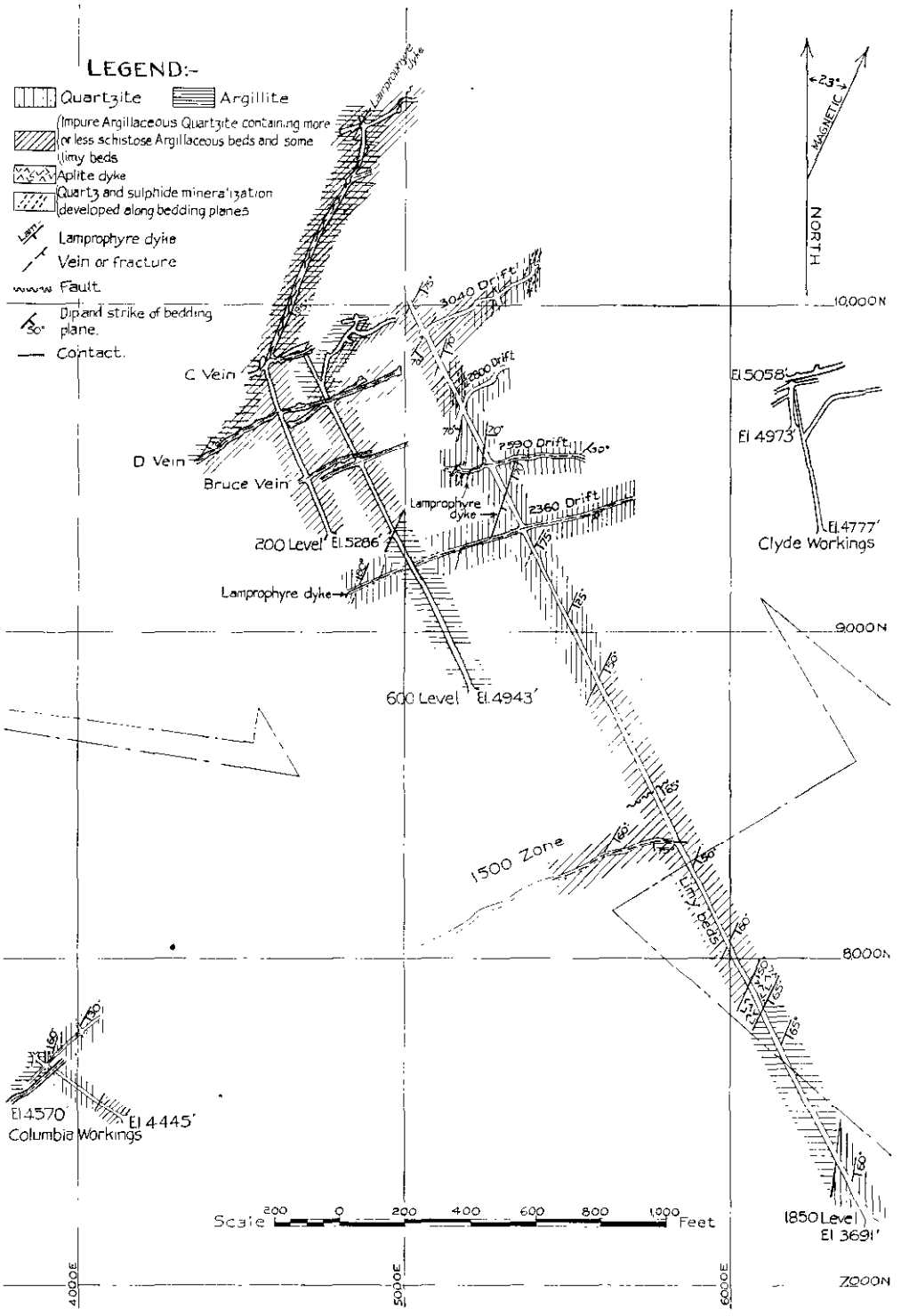
A branch road half a mile in length runs from the Sheep Creek Highway near the *Reno* mill to the lowest workings and camp, a distance of 11½ miles from Salmo. The upper workings are served by a branch from the road to the *Reno* mine, the distance from Salmo being about 14½ miles.

The ground north of Sheep Creek is principally underlain by rocks of the Reno formation, though the western side of the holdings is underlain by rocks of the Pend d'Oreille formation. The workings are principally in rocks of the Reno series, consisting of brittle light-coloured quartzites, dark rather impure quartzite, some limestone, and argillites that may grade into phyllites. In general the beds strike about 15 degrees east of north and dip steeply to the east. However, there is a good deal of local variation in the bedding; steep westerly dips on the western side of the hard quartzites suggest local folding; elsewhere there seems to have been adjustment along faults.

A fault is encountered near the inner end of the 200-level adit. It has been followed for about 800 feet north-easterly by a drift. The horizontal displacement appears to be about 20 feet, the south-east wall having moved north-easterly relative to the north-west wall. The fault is marked by shearing that in a general way follows the bedding, which strikes about north 22 degrees east. It dips very steeply to the east. Shearing at the end of the 600-level adit probably represents the same fault. A deep steep-walled gulch of the same general trend, which runs southerly past the *Columbia* No. 1 portal, is probably the surface expression of the same fault.

A large aplite sill, probably that shown on the Geological Survey map of the area (Map 299A), is exposed on the 1,850 level. This intrusive is 70 feet thick and appears to follow the bedding of the rocks in which it occurs. The quartzite adjoining the sill, particularly to the west, appears to have been considerably altered as a result of the intrusion.

A series of fractures cut the bedded rocks. These fractures strike from north-east to about due east. Generally they dip steeply to the south, though at places the dips may be vertical or steep to the north-west. Quartz-filling in the fractures is usually much wider in the quartzites than in the argillites. In the zone of oxidation fine free gold may be panned



Gold Belt Mining Co., Ltd. Plan of Workings after Company's Plan.

frequently from the vein-matter. In the unoxidized parts of the veins gold appears to be associated with pyrite, pyrrhotite, galena, and sphalerite. To date high values in veins in the *Gold Belt* ground have been limited to narrow widths usually at comparatively shallow depth, though on the 1,850 level, far below the zone of oxidation, assays in excess of an ounce of gold per ton have been obtained from sulphide mineralization. Black fine-grained dykes occur frequently in the main mass of hard quartzites. These dykes in places follow bedding-planes, and in others cut them, then invade and tend to follow the vein-fracture and may occupy most of a fracture for a considerable distance. Where the dykes cut veins there may be a small displacement. Along some bedding-planes, quartz veinlets branch from the main veins, accompanied by heavy impregnation of the quartzite by pyrite and pyrrhotite. This feature was noticed particularly toward the western side of the quartzite, and there is an apparent coincidence between the occurrence of quartz-impregnated, pyrite-mineralized quartzite and the lamprophyre dykes. The heavily-mineralized quartzite appears to carry negligible values in gold.

The Gold Belt Mining Company was incorporated early in 1933 to take over the assets of a private company of the same name formed the previous year. In addition to the claims mentioned in the first paragraph of this report, the company at one time had an option and did work upon claims of the *Golden Belle* group. The ground held by the company includes a number of claims on which considerable work had been done previously. The *Joint, Double Joint,* and *Golden West* claims had lain idle since about 1906. Some work was done on the *Columbia* and the *Navada* in 1909.

The *Clyde Belt* group was under development by the Britannia Mining and Smelting Company in 1910 and 1911. The ground had long been inactive when acquired by the private company. References to the various claims or groups will be found in Annual Reports of the Minister of Mines from 1900 to 1910, under *Columbia* in 1928, and under the name of the company from 1932 to date. References also appear under *Gold Belt* and *Clyde Belt* in Memoir 172 of the Geological Survey of Canada.

After extensive surface prospecting, underground work was undertaken by the company on what are known as the 200 level and, later, on the 600 level of the *Gold Belt* workings. These adit-levels start as crosscuts on the *Clyde* claim and extend into the *Bruce Fr., Sunbeam Fr.,* and *Double Joint* claims. The old *Clyde Belt* workings are on the *Belt* claim. Work was also done on the *Golden Belle* group and a car of ore was shipped from these workings in 1933. In 1934, 291 tons of selectively-mined ore was shipped to the smelter at Trail from stopes above the 200 level of the *Gold Belt.*

Early in 1935 arrangements were made for financing by North American Mines, Inc., of Boston, and development on a programme outlined by the engineers of that organization is still in progress. Diamond-drilling was done below the 600 level. Subsequently the compressor plant was transferred to a site on the *Lily D.* claim, and the 1,850 level, 1,250 feet below the 600 level, was started as a crosscut which was driven northerly for approximately 3,150 feet. Drifts from this crosscut have been started at five points. Work has also been done on the *Columbia* claim, consisting of trenching, advancing the old adit, and driving a new adit 125 feet below the old one. This work was suspended early in the fall of 1936.

Workings on this property are extensive; horizontal workings underground aggregate about 2½ miles in length. Work on the 1,850 level alone to the end of 1936 amounted to about 1¼ miles. The surface workings and the upper *Gold Belt* levels are described in the Annual Reports of the Minister of Mines from 1932 to 1934, inclusive, and in Memoir 172 of the Geological Survey. The earlier work is reviewed here and recent work described in detail. The names of the workings and their relative positions are shown on the accompanying plan. Such geological features as can be indicated on a small-scale plan are also shown.

The early surface work done by the present company was above the present *Gold Belt* 200 level. Prospecting was designed to discover the westward extension, into the Reno quartzite, of veins known, in the Quartzite Range formation to the east, as the Motherlode vein system.

In the 1932 Report of the Minister of Mines, B. T. O'Grady described the results obtained by surface-trenching, from which the following is quoted:—

" The ' Reno ' quartzite where it traverses the *Gold Belt* property has a width of 750 feet, measured stratigraphically, and a width of 1,100 feet measured along the strike of the vein-fractures. These are filled with quartz and crushed country-rock and the ore consists of

pyrite, galena, and sphalerite sparingly distributed through the quartz, with free gold visible in numerous specimens. Unlike the extensively oxidized condition which prevailed in the upper parts of ore-bodies in other mines of the camp, such as, for instance, at the *Reno* and *Nugget* properties, oxidation is very shallow or entirely absent, primary ore being exposed at the surface as in the 'C' vein-outcrop referred to hereinafter.

"Free gold is visible in specimens at numerous points for a length of 130 feet of the ore-shoot, and in this section a grab sample, from which obviously rich specimens were excluded, assayed: Gold, 1.44 oz. per ton; silver, 0.6 oz. per ton; lead, trace; zinc, 1 per cent. Next in apparent importance is the *Bruce* vein, which was slightly explored by old workings, including a 23-foot shaft, at the bottom of which is a 12-foot drift to the east. This is a strong quartz vein which, according to the management, gives fair assays.

"The 'A' and 'B' veins have shown good values in places, but no continuous ore-shoot has been exposed as yet."

The extensive development done by the company on the 200 level was largely completed by the end of 1934. The workings include an adit-crosscut driven 550 feet at north 23 degrees west, with drifts east and west on three veins. The end of the adit exposes a fault striking about north 22 degrees east and dipping very steeply to the east. This fault is close to the western margin of the harder quartzites. Beyond the fault the rocks are sheared argillites with some limy beds. The contact between the argillaceous quartzites and the softer argillites is gradational. In a general way the fault follows the strike of the formation. The fault crosses the adit at the commencement of "C" vein-drift. Beds on the south-east side of the fault have been displaced about 20 feet north-easterly in relation to the corresponding beds on the north-west side.

From near the end of the adit a drift follows the shearing north-easterly. Rather more than 1,200 feet of work has been done in driving along the fault, in drifting along some narrow fractures, and in crosscutting. The rocks are chiefly sheared argillites, though some platy quartzite and some massive argillaceous quartzite are encountered toward the end of these workings. The fractures or small shears on which drifting has been done contain but little quartz, and that poorly mineralized.

The three veins drifted upon from the adit and their respective distances from the portal are: *Bruce*, 176 feet; "D," 388 feet; and "C," 535 feet.

The *Bruce* vein in the drift to the west and for 20 feet to the east of the adit is in soft argillaceous rocks, where it is represented by 1 to 2 feet of shearing containing a little white quartz. From 20 to 150 feet east the wall-rocks are harder and the vein-shear contains from 6 to 18 inches of white quartz. Beyond this point the vein is weaker in softer rocks.

"D" vein, from 15 to 75 feet west of the adit, is stoped to a height of 15 to 20 feet above the drift-floor. In this section the fracture has a width of from 10 to 16 inches and contains quartz from 6 to 10 inches thick. Beyond the stoped section the wall-rocks are softer and at the end of the drift are schistose. Some quartz occurs along the shearing principally as small lenses. East of the adit the vein is stoped to about 12 feet above the floor for 65 feet, the vein containing from 6 to 9 inches of quartz mineralized with fine pyrite. A sample across 8½ inches of quartz assayed: Gold, 0.46 oz. per ton; silver, 0.35 oz. per ton. For the next 55 feet the roof of the drift is high; in this section the wall-rocks are argillaceous. Thence for 100 feet the ground has been stoped above the drift. At the east end of the stope the roof is 30 feet above the floor of the drift. At the west end the roof is higher. Two raises continue above the roof. The stope has a width of 1½ to 3½ feet. The vein is rather irregular in dip and strike and consists of shear-gouge, crushed wall-rock, and quartz well mineralized with pyrite. The width between walls varies from 1 to 2 feet, of which the quartz occupies possibly one-third. The walls are softer at the east end of the stope and the vein is weaker than at the west end. East of the stope the wall-rock is generally argillite and the shearing is rather tight, with occasional lenses of vein-quartz. Some quartz is developed in the wall-rocks.

In "C" vein-drift, east of the adit, the rock is generally sheared argillite and the fracture is narrow. From 20 to 60 feet east of the adit there is from 4 to 10 inches of quartz in the fracture and a considerable width of quartz is developed in the wall-rock. At 60 feet a strand of quartz goes into the north wall, but shearing containing some quartz-lenses continues to the face. A raise to the surface, 220 feet above the 200 level, starts from the drift 35 feet

west of the adit. The lower part of the raise is in soft faulted ground. The ground in the upper part of the raise and at the surface is more favourable. Concerning this section the following is quoted from the 1934 Report by B. T. O'Grady:—

"Drifting was done on the 50-, 90-, and 120-foot levels measured down from the top. Along the outcrop the ore-shoot is 155 feet long. Stoping has been done for this length between the surface and the 50-foot level, where drifts extend 105 feet to the east and 71 feet to the west. Drifts started at the 90-foot level are in 28 feet to the east and 20 feet to the west. On the 120-foot level drifts extend 284 feet to the east and 22 feet to the west. In the eastern working the first 30 feet from the raise is in a fault-zone, from 30 to 50 feet ore has been stoped, and from this point to the face spots of high grade, which will be mined for shipment, occur in the quartz."

Shipments made in 1934 came from the stopes on "C" and "D" veins. The following information regarding the shipments is also quoted from the 1934 Annual Report:—

Dry Weight (Pounds).

From "D" Vein.	From "C" Vein.	Gold Assay. Oz. per Ton.
91,198	----------	4.155
----------	89,019	1.456
----------	97,773	1.47
----------	94,144	1.6375
46,125	16,000	2.021
67,782	----------	2.0755
----------	80,000	1.714

600 Level.—This level is 343 feet below the 200 level. The main adit is in 1,180 feet, cutting the *Bruce* vein at 750 feet and the "D" vein at 990 feet from the portal. A drift runs to the north-east along the formation at 1,030 feet from the portal, while at 1,160 feet from the portal there are drifts on what is probably the "C" vein. On this level the rocks are generally less quartzitic. They consist largely of sheared or platy argillites with argillaceous quartzite and some limestone. The veins are represented by irregular strands of shear-gouge containing lenses or stringers of quartz. Quartz also follows the bedding of the formation adjacent to the fissures. The *Bruce* and "D" veins contain some sections in which there are fair quartz-lenses, but the "C" vein or fissure and the workings from the formation drift to the north-east show only gouge with small stringers of unmineralized quartz.

In "D" vein-drift, from 60 to 120 feet west of the adit, there is from 2 to 3½ feet between the walls of the fissure and in the filling there is up to 1⅓ feet of quartz. At 110 feet from the adit a raise follows the fissure. The ladder-way extends to 85 feet above the level, at which point there is no quartz in the fissure.

1,850 Level.—This level, 1,250 feet below the 600 level, includes an adit 3,150 feet long running into the mountain on a course of north 26 degrees 30 minutes west. Drifts from this adit are the "1,500 zone" drift at 1,300 feet from the portal, and the "2,360," "2,590," "2,800," and "3,040" drifts, the number indicating the approximate distance of the drift from the portal of the adit.

The driving of this level was undertaken after studies of surface exposures and of the upper levels, by engineers of North American Mines, Incorporated, had suggested that a greater width of hard quartzite would be found at depth. This theory was tested by drilling three diamond-drill holes downward from the 600 level.

On the 1,850 level the adit crosscuts good quartzite for about 1,100 feet, the true width of the quartzite being a little less than 800 feet. The main body of quartzite of the Reno formation was encountered at about 1,830 feet from the portal, and extends to about 2,900 feet, where it grades into thin-bedded argillites, with some limestone exposed at the end of the adit. The adit starts in grey quartzite probably belonging to the base of the Quartzite Range formation; thence it passes through argillaceous beds from 200 to 700 feet. At 700 feet it enters a body of aplite, of which the south-easterly contact conforms to the bedding, and leaves the aplite, at about 790 feet, to enter quartzite. Near the contact the quartzite appears to have been altered by solutions from the intrusion and is distinguished from the aplite with some difficulty. The aplite appears to be a sill, the true width of which here is about 70 feet. Beyond this to the main mass of Reno quartzite the rocks exposed consist

of ribs of grey quartzite, interbedded with black argillaceous quartzite, argillites, and limestone, the softer argillites and limestone predominating. Throughout the adit the beds have about the same general strike, but vary locally from due north to 30 degrees east of north. The dips are predominately to the east or the south-east, and from the portal to the main mass of the Reno quartzite are generally from 65 to 50 degrees. In the main quartzite, however, the dips to the east become much flatter, this being particularly noticeable in the 2,590 drift east. In the adit between the 2,590 and 2,800 drifts the quartzite is massive, disturbed, and jointed, some of the joints being filled with black lamprophyric dyke-matter. At the 2,800 drift the dip of the beds has reversed and is steep to the north-west. This is also the case at the west end of the 2,360 drift. Here, as at some other points close to lamprophyre dykes, the quartzite-beds have been impregnated with quartz and pyrite over a considerable width. A sample of such material assayed: Gold, trace; silver, 0.6 oz. per ton. Beyond the 2,800 drift the beds dip steeply to the south-east. This is also true of the argillite and limestone north of the gradational contact.

1,500 Zone.—From 1,300 to 1,500 feet from the portal there are several shears or fractures which have a general east-west trend, one of these at 1,300 feet containing some quartz. This shearing has been followed westerly, and when the property was visited last in November this drift had reached a distance of about 400 feet from the adit. To that point it was in soft rocks and did not contain commercial mineralization. This drift is still being advanced westward. It was reported that the quartzite was entered about where the end of the drift is shown on the plan. More recent reports are that a quartz vein is now being followed in the quartzite.

2,360 Vein.—This vein has a width of 13 inches of quartz at the adit, pinching somewhat for 10 feet west, then widening to 2 feet, 30 feet west of the adit. In this length it is fairly well mineralized. A sample at 20 feet west across 13 inches assayed: Gold, 0.46 oz. per ton; silver, 0.2 oz. per ton. Thence to 105 feet west the vein is from 1 to 2 feet wide and banded, but is reported to contain very little gold. From 105 to 200 feet, lamprophyre dyke-rock occupies much of the fracture. From 200 to 450 feet there is from 2 to 6 feet of quartz largely unmineralized, but usually showing some banding toward one wall and occasionally containing patches of sulphides. Thence to the face at 590 feet the fracture is largely occupied by dyke-rock. At the face the light-grey quartzite wall-rock, dipping at 80 degrees to the west, is impregnated with quartz and sulphides.

In the drift to the east the vein widens to 3½ feet at 20 feet, where the following samples were taken: North side, 1 foot, vein-wall and well-mineralized quartz: Gold, 1.22 oz. per ton; silver, 1 oz. per ton. Remainder of vein, 2½ feet of white quartz unmineralized: Gold, trace; silver, trace. Going east, the vein widens to 6 feet at 80 feet, but is poorly mineralized. It narrows again to 2 feet at 140 feet; a sample across the wide section assayed: Gold, trace; silver, 0.8 oz. per ton. The vein widens again to 4½ feet of white quartz at 185 feet. At 195 feet the vein splits and from this point on there is comparatively little quartz, and that tends to run off into the bedding. At 230 feet there is a short crosscut to the south at a point where a shear comes in from the south wall. From this point to 320 feet east there is from 2 to 5 feet of shearing with some quartz along the north wall. In this section the walls are argillaceous. Thence to the face at 355 feet the shearing is narrow; in the face it is 6 inches wide in black argillaceous quartzite.

The 2,590 drift follows a vein east and west of the adit. Twenty feet west of the adit the vein is represented by 6 inches of quartz, and continues at this width to 30 feet, where a lamprophyre dyke enters the fracture from the north and follows west along the vein for 20 feet before it leaves the fracture to follow the beds into the south wall. Thence the vein is narrow for some distance west. From 100 to 118 feet the fracture is occupied principally by dyke-matter. In the vicinity of the dykes the quartzite in the walls is impregnated with quartz, pyrite, and pyrrhotite. From 118 to 145 feet the vein has a width of 11 to 15 inches of quartz mineralized with pyrite, galena, and sphalerite. At 140 feet a sample across 1 foot of well-mineralized quartz assayed: Gold, 1.2 oz. per ton; silver, 1 oz. per ton; lead, *nil*; zinc, 1 per cent. From this point on, the vein is quite narrow. From a width of 6 inches, 20 feet west of the adit, the vein increases to 1½ feet in the adit, where a sample across 8½ inches of well-mineralized quartz assayed: Gold, 0.52 oz. per ton; silver, 1.6 oz. per ton. This is the south half of the vein; the north half is scarcely mineralized. The vein is followed

east to a point 280 feet from the adit. It has a width of 7 to 12 inches to 85 feet, where it is cut by a 2-foot lamprophyre dyke. East of this there is from 1 to 18 inches of quartz in the fracture, though the fracture, with included horses of quartzite, may be up to 2 feet in width. A second dyke cuts the vein at 180 feet. Company sampling of the vein gave low values, except for short sections in the west drift and at the adit.

In the first 50 feet the 2,800 drift east follows grey quartzite-beds which dip to the west and are impregnated with quartz and sulphides; similar impregnations are mentioned at various other points. The face of the drift was at 50 feet when the property was last visited. A short drift also extends south-west following the same beds.

The 3,040 drift starts in thin-bedded quartzites interbedded with argillite north of the main mass of quartzite. It follows an irregular fracture from which splits run off along the bedding-planes. There is little quartz present. At 185 feet from the adit the drift swings to a more easterly course at a roll in the bedding of the formation. There is some limestone on the south wall at the centre of the roll. From this point on the fracture is rather weak.

Of the drifts on this level, the 2,800 and the 3,040 were not impressive, while the 1,500 zone-drift had not entered the quartzite when the writer last visited the property. The 2,360 and 2,590 veins, on the other hand, are strong, and at the time of examination there was still a considerable distance easterly along the strike in which the fractures should be in quartzite. West of the adit both fractures are occupied in part by lamprophyre dyke-rock. In general the quartz in these veins is poorly mineralized, while some of the mineralized sections do not carry values. However, other well-mineralized sections on both veins do carry values in gold, which, even though spotty, indicate that some of the primary sulphides carry encouraging values. Commercial concentrations of such mineralization might be found on the extensions of these veins or at another horizon. A short section in the 2,360 vein lying on each side of the adit might be regarded as commercial.

Columbia Workings.—These workings are situated about half a mile west of the 1,850-level portal. They consist of surface-stripping along a vein; No. 1 level at 4,570 feet elevation is approximately 880 feet above the 1,850 level, and the No. 2 level is at 4,450 feet elevation.

No. 1 level, an adit, starts on the western side of a ridge which slopes steeply to a deep draw. This draw is probably the surface expression of the fault encountered at the inner end of the *Gold Belt* 200 level. The adit is 218 feet in length and is driven north-east through platy beds, passing to more massive beds of quartzite near the face. In the first 60 feet there is from 4 to 6 inches of rusty quartz; from there for some distance the vein is tight; the roof of the working is altered and quite rusty. Near the face there is from 2 to 3½ feet of sheared quartzite containing 50 per cent. of vein-quartz mineralized with pyrite. Free gold can be panned from rusty material in the cut and in the outer part of the adit, where the vein is narrow. In these sections high values in gold have been obtained over narrow widths, but the greater width at the face carries very low values.

No. 2 level adit starts from the south-eastern side of the ridge and is driven north-west for about 360 feet. To 150 feet from the portal the rocks are platy and argillaceous; thence to 300 feet they are light-grey thick-bedded quartzites striking a little east of north; thence to 360 feet the beds are argillaceous. At about 345 feet is 1 foot of shearing following the bedding, which dips at about 70 degrees to the west. The shear contains about 6 inches of quartz and much rust. A drift on this shearing extends 20 feet south and 4 feet north.

At approximately 285 feet from the portal a drift goes south 10 degrees west for 30 feet, following thick beds of quartzite which dip 60 degrees to the west. This is practically at the contact of the quartzite with the argillaceous beds to the west. A fracture striking about due north and dipping 55 degrees to the east cuts the beds of quartzite, which are impregnated with quartz and pyrite over a width of about 6 feet.

From the same point in the adit a drift extends 90 feet south-west, following a fracture with smooth walls, which strikes south 40 degrees west and dips 65 degrees to the north-west. Both sides of the drift are in argillite. There is a little quartz along the fracture. A drift follows the fracture from the adit north-easterly in the quartzite for 224 feet. From 25 to 35 feet from the adit the thick quartzite-beds north-west of the fracture are heavily impregnated with quartz and pyrite. North-east of this point the fracture is strong, 6 inches to

2½ feet between the walls, and a good deal of quartz is developed in the fracture and in the wall-rock along it. At 100 feet from the adit a sample across 1.6 feet of quartz mineralized with pyrite assayed: Gold, 0.14 oz. per ton; silver, 0.3 oz. per ton. The vein is somewhat sinuous. Beyond this point it narrows rapidly and continues as a tight fracture to the face, where it dips 75 degrees to the north-west. At 150 feet from the adit there is a short crosscut on each side of the drift. Here the beds strike north 25 degrees east and dip at 30 degrees to the east, in contrast with the westerly dip of the beds at the adit.

Kootenay Ore Hill Gold Mines, Ltd.

Five Crown-granted claims, *Ore Hill, Dixie, Ore Hill Number Three, Standard,* and *Last Dollar Fractional,* known as the *Ore Hill* group, with three adjoining claims, *Royal Ann, Royal Ann Number One,* and *Royal Ann Fractional,* held by location, have been acquired by the above company from the vendor, J. Gallo. The head office of the company is given as in the Credit Foncier Building, Vancouver. The claims are situated in the Sheep Creek area of the Nelson Mining Division. They are near the head of Billings (Coon) Creek, lying principally to the east of the creek and immediately north of the *Summit* group.

Billings Creek flows northerly to Sheep Creek at a steep gradient between spurs from Mount Waldie. Precipitous outcrops of quartzite form a rim to the south and east at the head of the creek, while to the west softer rocks of the Pend d'Oreille series stand out less prominently. Below the rim there is a considerable thickness of overburden, with occasional rock-outcrops on the steeper slopes. In slightly more than half a mile from north to south the ground covered by the Crown-granted claims rises from 5,000 to 6,000 feet elevation. The present workings are situated near the creek at elevations from about 5,200 to 5,500 feet.

A truck-road has been built to the property from the short branch road connecting the *Queen* mine with the Sheep Creek Road. The new road climbs 1,850 feet in a distance of 3¼ miles, the upper end of the road being convenient to the new upper adit on the *Ore Hill* claim.

As mapped on the Salmo Sheet (Map 299A, Geological Survey of Canada) the area covered by the Crown-granted claims is underlain by rocks of the upper part of the Reno and the lower part of the Pend d'Oreille formations. Where best exposed on the ridge east of Billings Creek, the rocks of the Reno series consist of light-coloured quartzites with which occur some bands of crystalline limestone up to 30 feet in thickness. The Pend d'Oreille series is covered in most places by overburden, but is exposed occasionally along the creek. The contact is mapped as crossing Billings Creek near the head and trending somewhat east of north. The present workings are principally in rocks of the Pend d'Oreille series, which have been much folded and contorted. These rocks are dark argillaceous quartzites, argillites which may be more or less sheared, dark impure limestone usually thin-bedded, and crystalline limestone in which bedding-planes are poorely developed. The beds strike generally east of north, but vary from 10 degrees west to 40 degrees east of north. The dips are generally steep to the east, but vary from about 40 degrees to the east to steep to the west.

One type of mineralization observed is replacement of limestone along the bedding by sulphides of lead, zinc, and iron. An old surface cut and adit, east of the creek somewhat north of the blacksmith-shop, show quite good lead-zinc mineralization over a width of 3 to 4 feet. It is reported that this mineralization is low in gold and silver.

Galena, sphalerite, pyrrhotite, pyrite, and a little chalcopyrite also occur with quartz in fractures. Where one or both walls of the fracture is in limestone the mineralization may consist of almost solid sulphides, which appear to have replaced the limestone, giving rise to lenses up to several inches in thickness. In such places there is also a tendency for the mineralization to follow along the bedding as solid sulphide or as disseminated grains. The highest values in gold have been obtained in solid sulphides containing a good deal of lead, but quite good values have also been obtained in quartz mineralized with pyrrhotite or with pyrrhotite and sphalerite. Silver values are comparatively low.

In the soft rocks of the Pend d'Oreille series the fracturing is weak and the widths narrow and irregular. Though occasionally branching fractures may give a width of 2 feet or even greater, in general the commercial mineralization appears to be limited to small lenses of sulphides. The present upper adit-level has penetrated argillaceous quartzites to the east, which are regarded as more favourable for occurrence of fissure-veins.

There are several old workings in the ridge east of Billings Creek and below the *Summit* workings. Apparently this work was done from 1910 to 1917, in which period brief references to the *Ore Hill* group appeared in the Annual Reports of the Minister of Mines. During that period a mill with a capacity of about 7 tons daily was built, equipped with a crusher, stamps, Wilfley table, and Johnstone Frue vanner.

In 1934 Joe Gallo optioned the five Crown-granted claims and obtained the three locations mentioned above. In 1935 a small stope was opened from the surface near the *Summit* boundary. High-grade ore from a narrow vein in limestone was mined and sacked. Some ore was also sorted from old dumps. A surface trench opened mineralization for a length of 60 feet along fracturing in limestone. In December an adit was started at a depth of 100 feet below the surface cut. A small compressor driven by a Diesel engine was installed. During 1936 the adit was continued to a length of 385 and considerable drifting was done from it. Another adit 180 feet lower was driven 1,095 feet and some drifting done. On the upper level a small stope was opened from a drift to the west. The ore shipped during the year came principally from the upper level, but included ore sacked in 1935. Shipments in 1936 totalled 427 tons, containing 686 oz. gold, 1,080 oz. silver, 47,707 lb. lead, and 40,083 lb. zinc.

In October a mill was constructed convenient to the portal of the lower adit, equipped with a 6- by 8-inch jaw-crusher, a Straub Rib-Cone ball-mill approximately 15 by 30 inches, and a Straub table 8 by 4 feet, all driven by a Fairbanks-Morse 25-horse-power Diesel engine. It is understood that the capacity of the plant has been increased to about 15 tons per day by the addition of a second small ball-mill. New camp accommodation has also been provided.

On *Ore Hill* ground, in addition to old workings lying below the adits on the *Summit* group, there are at least seven adits east of Billings Creek. Of these, two are comparatively near the creek apparently in rocks of the Pend d'Oreille series, while the others in the ridge well above the creek are probably in the Reno formation. Most of these workings are now largely caved. The writer visited the old workings, but found little evidence of commercial mineralization in those now accessible. The course of fractures across the disturbed weak rocks of the Pend d'Oreille series between the old workings and the current workings is difficult to predit. The writer visited the property on several occasions from October 11th, 1935, to October 2nd, 1936. The following description of workings covers conditions to the latter date:—

On the *Standard* claim, north of the No. 3 adit of the *Summit* workings, is a caved adit; farther down the hill to the north is an open-cut about 100 feet long. The cut is from 6 to 12 feet wide and apparently follows shearing along the bedding, in which some quartz and sulphides were developed. The old camp lies a short distance to the west. Another rock-cut 30 feet north-east of the first is about 20 feet long and exposes a fracture cutting the beds. The fracture is tight at both ends of the cut and in between is from 2 to 6 inches in width. It is filled with quartz and some sulphides. The trench, 60 feet in length, made in 1936, is a further 40 feet down the hill. It cuts through 2 to 4 feet of overburden and exposes white crystalline limestone. The limestone strikes about north 15 degrees east and dips steeply to the east. Two narrow fractures striking about north 75 degress east and dipping steeply to the north are exposed for most of the length of the cut. The fractures, in widths from a crack to perhaps 3 inches, are filled with mixed sulphides. Sulphides are also developed in streaks and disseminated grains along the bedding-planes of the limestone. At the east end of the trench a fracture striking north 60 degrees east was observed. A sample of sulphide from the trench assayed: Gold, 0.88 oz. per ton; silver, 5 oz. per ton; lead, 5 per cent.; zinc, trace. Cuts a little farther to the east do not show similar mineralization.

The new upper adit is driven from a point just west of the creek 100 feet lower than the trench, on a course south 4 degrees east. It cuts limestone and more or less sheared argillite to 310 feet from the portal; thence to the face at 385 feet it cuts dark argillaceous quartzites. At 310 feet from the portal there is some shearing along the contact between limestone on the north and argillaceous quartzite to the south, and also fracturing that probably is the downward continuation of the fracturing in the surface cut. A fracture runs westerly into the limestone, and another running north-easterly cuts the dark argillaceous quartzite. The fractures dip steeply to the north. In the shattered ground some quartz is developed and

considerable galena, sphalerite, and pyrrhotite occur over a width of about 2 feet. Some mineralization appears to follow northerly along the contact. The mean of two samples across a width of 2 feet was: Gold, 0.53 oz. per ton; silver, 1.4 oz. per ton. Selected sulphide assayed: Gold, 1.34 oz. per ton; silver, 2.6 oz. per ton; lead, 7.3 per cent.; zinc, 17.9 per cent. Ten feet south of the drifts is a fracture running about east-west in the argillite and dipping 40 degrees to the north. This fracture contains up to 1½ inches of sulphides.

A drift to the west at 310 feet from the portal follows the fracture in limestone for 80 feet at south 75 degrees west. The face of the drift is in argillite striking north 35 degrees east and dipping 50 degrees to the south-east. From 5 to 30 feet is a stope, and in this section appears a streak of solid sulphides from 2 to 6 inches in width. There is also less regular mineralization following bedding-planes. West of the stope the vein is generally less than 2 inches thick and is represented in the face by a ½-inch quartz stringer.

Another drift from the same point extends for 315 feet on a general course of north 57 degrees east. In the first 12 feet the 2-foot mineralized width pinches down to 3 inches of gouge, which is followed for 40 feet where a shear cuts across the working. Beyond this the working had little to follow. At 90 feet a branch turns to the left at north 25 degrees east in argillaceous quartzite. The right-hand branch follows the general course along narrow fracturing which comes in from the south wall at 95 feet. The fracturing cuts argillites and argillaceous quartzites and is marked by quartz occasionally as much as 6 inches wide. Near the face the fracturing is very weak. At the face in argillaceous quartzite a crosscut driven to the south-east had just entered a vein of easterly strike and dipping at about 30 degrees to the north. The width of this vein was not exposed, but it appeared to consist of not less than 2 feet of well-mineralized quartz.

At about 20 feet inside the portal of the new upper adit mineralization was discovered in limestone. This has been followed by drifting for 20 feet at south 40 degrees west. The ground is somewhat broken and the minerals are oxidized. In the face 4 to 8 inches of mineralized quartz dips to the north-west at 35 degrees. A sample across the full width assayed: Gold, 1.52 oz. per ton; silver, 0.1 oz. per ton; lead, trace; zinc, 3 per cent.

The lower adit has been driven for 1,095 feet at south 7 degrees east from a point just west of the creek 180 feet below the upper adit and 610 feet north of the upper portal. It is driven through limestone and argillite with some argillaceous quartzite. Locally the beds show wide variations in dip and strike. At 350 feet from the portal there is a fracture along which there has been some displacement. A lens of sulphide with a maximum thickness of 8 inches, containing abundant galena, extends from the roof half-way down the west wall and north-easterly pinches out in the roof about 8 feet from the west wall. The fracture, cutting argillaceous quartzite interbedded with limestone, has been followed north-easterly for 95 feet. The fracture dips from 50 to 70 degrees to the north-west and is offset somewhat by faults at several points. Along it there may be up to 4 inches of quartz mineralized with varying amounts of sulphides. Ten feet from the face 4 inches of quartz well mineralized with pyrrhotite assayed: Gold, 0.94 oz. per ton; silver, 0.05 oz. per ton; lead, *nil*; zinc, 1.5 per cent.

At 865 feet from the adit-portal a drift has been driven 50 feet at south 60 degrees west, following a rather tight fracture. In the face 3 inches of limestone showed fracturing and contained a little sphalerite. A fracture 25 feet in striking south 30 degrees west and dipping rather steeply to the south-east has been followed for 15 feet by widening the drift. A little scattered mineralization is developed in the limestone adjacent to this fracture.

Lone Silver. Three claims, known as the *Lone Silver*, *Lone Silver Number Two*, and *Lone Silver Number Three*, are recorded in the names of John and Robert Sapples, of Salmo. Recently the claims have been under lease to E. Berg, S. Heidler, and E. Reulle. The property was formerly known as the *Hope* mine. The claims are situated east of Rosebud Lake, in the Nelson Mining Division. They are reached by a fair road which leaves the Nelson–Nelway Highway at a point 10⅓ miles south of Salmo, just past the South Fork of Salmo River. The branch road climbs to a bench; then follows an easy grade south-east to a point 2 miles from the main road, where a branch approximately 1 mile in length goes south-easterly to the workings.

The lake lies in an area of flat-lying land at approximately 2,650 feet elevation. Immediately south-east of the lake a hill rises to an elevation of 3,700 feet, and from it a ridge about 400 feet above the flat extends somewhat north of east for a mile. The claims lie on the north-facing slope of the hill and ridge. The whole section of country has been burned over in recent years.

Rock-exposures on the ridge consist of dark, more or less dolomitic limestone and platy argillites of the Pend d'Oreille series, striking generally east to west and dipping steeply to the south. In the vicinity of the workings the rocks are disturbed and faulted.

Mineralization in general follows bedding-planes along which there has been some movement. Quartz and sulphide minerals have entered the various openings. Surface alteration has resulted in formation of azurite and malachite, probably secondary after grey copper. Some galena is to be seen. Early shipments carried values in silver, while shipments in 1936, though not high in silver, carried good values in gold.

Before the war the property, then the *Hope*, was explored by four adits, and it is understood that some six cars of high-grade silver ore were shipped. The claims lapsed and lay idle until 1935. In 1936 lessees reopened the most westerly adit and mined some high-grade shipping-ore. Three small shipments of sorted ore totalled 23.65 tons and averaged approximately: Gold, 2.2 oz. per ton; silver, 48 oz. per ton; lead, 5 per cent.; zinc, 3.5 per cent.

The four adits are numbered from west to east; of these, 2 and 3 are caved at the portals. The first three are at about the same elevation, roughly 70 feet above the flat. No. 2 is 90 feet, and No. 3 is 225 feet from No. 1 on a course of north 65 degrees east. No. 4 adit is about 175 feet south 45 degrees east from and 105 feet higher than No. 3.

At about 100 feet south 60 degrees east from the portal of No. 4, and 80 feet higher, an old stope comes through to the surface. From this a badly-caved cut extends 60 feet south 70 degrees east. The cut appears to have been made along a schistose-greenstone dyke, largely carbonatized. Near the west end there is a width of 8 inches of brecciated dolomitic limestone impregnated with quartz and showing some copper-stain.

The adit below is driven south-easterly for 50 feet, cutting through sheared argillite and dolomitic limestone, which strike north 60 degrees east and dip 65 degrees south-easterly. The working then turns south for 10 feet to connect with a short stope about 5½ feet wide. The hanging-wall strikes south 70 degrees east and dips 70 degrees southerly. From the stope a drift extends 8 feet westerly. Stoping extends below the level. The roof of the drift and the stope consists of brecciated and altered dolomitic limestone, showing some rust. Along the hanging-wall there is from 3 to 8 inches of quartz with a good deal of copper-stain.

Three samples were taken here:—

Sample.	Gold.	Silver.	Copper.	Lead.	Zinc.	Description.
	Oz. per Ton.	Oz. per Ton.	Per Cent.	Per Cent.	Per Cent.	
No. 1	Trace	16.0	0.3	Trace	0.5	Face of drift, No. 4 level; 5-inch quartz with copper-stain along hanging-wall.
No. 2	Trace	1.0	*Nil*	*Nil*	*Nil*	Face of drift, No. 4 level; 5-foot brecciated limestone in foot-wall of No. 1.
No. 3	Trace	2.4	*Nil*	*Nil*	*Nil*	Roof of drift at collar; 4.5 feet brecciated limestone excludes 8-inch quartz at hanging-wall.

From a 40-foot cut through wash and rock, No. 1 adit goes in 105 feet at south 20 degrees west. At the portal limestone-beds strike north 60 degrees west and have a low dip to the south. There is a fault 55 feet from the portal about on the strike of the formation and dipping 55 degrees to the north. Just north of the fault the limestone also dips to the north. Thirty feet farther in is another fault of about the same strike, but dipping 25 degrees to the north. Between the two is graphitic schist. Beyond the second fault the rock is limestone; the beds stand vertically and strike south 35 degrees west. The first 55 feet of the adit crosscuts a shallow trough of limestone in which mineralization has been developed following

the bedding. Ore has been stoped from several small chambers to the west of the working. The following samples give a section obtained 10 feet west of the working at 30 feet from the portal:—

Sample.	Gold.	Silver.	Copper.	Lead.	Zinc.	Description.
	Oz. per Ton.	Oz. per Ton.	Per Cent.	Per Cent.	Per Cent.	
No. 4	0.01	71.0	8.3	7.0	9.5	3 inches sheared limestone showing copper-stain.
No. 5	0.12	5.0	0.1	*Nil*	3.0	14 inches shattered limestone below No. 4.
No. 6	0.90	33.5	1.2	3.0	3.0	9 inches of quartz with galena and copper-stain lying on 2 inches of gouge below No. 5.

Waneta Gold Mines, Ltd.

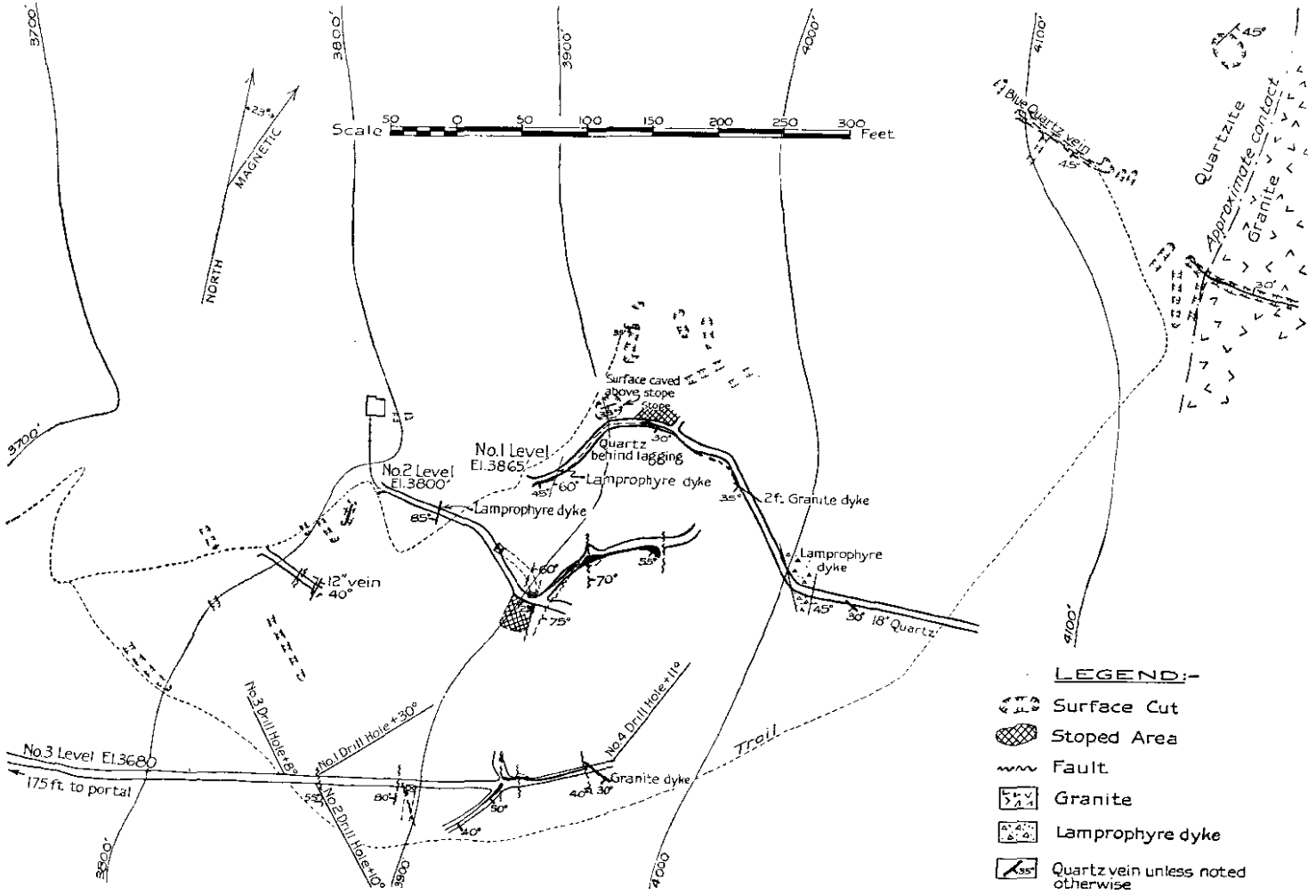
The property known as the *Bunker Hill* group, consisting of two Crown-granted claims, *Bunker Hill* and *Mormon Girl*, and surrounding them fourteen adjacent located claims, is owned by Waneta Gold Mines, Limited, of Nelson. The claims are situated on Limpid (16-Mile) Creek, north of the Pend d'Oreille River, in the Nelson Mining Division. Practically all the ground held lies east of Limpid Creek. The stream-valleys are deeply cut. The slope toward Limpid Creek is steep. Above the underground workings and somewhat to the north is a westerly-trending ridge, to the crest of which the slope is moderate. Bed-rock is generally heavily covered with overburden, though toward the crest of the ridge there are several outcrops. A branch road to the property leaves the Nelway–Waneta Highway at about 6½ miles from Nelway. In 4 miles from the highway to the mine camp the road climbs 1,800 feet.

The underlying rocks are mapped as "Reno series," intruded by granitic rocks of the Nelson batholith. Reference to the geology of the area and under "Bunker Hill" a description of the property appears in Memoir 172 of the Geological Survey of Canada. Mention is made of a north-easterly-trending major fault crossing the Pend d'Oreille River half a mile below the mouth of 15-Mile Creek and of minor faulting in the locality. References to the property also appear in the Annual Reports of the Minister of Mines for 1933 and 1934.

Rocks of the Reno series exposed on the surface and underground consist of impure quartzites, more or less sheared argillites, and impure limestones. These rocks are disturbed by folding and faulting. Within short distances there are great variations in the attitude of the bedding-planes. A large mass of granite outcrops some distance east of the underground workings and some granitic dykes have been exposed underground. There are also some lamprophyre dykes, along some of which there has been displacement.

A number of quartz veins have been partially developed by adits and surface workings. As indicated on the accompanying plan, these veins vary considerably in strike and dip and are displaced by faulting. The intensity of mineralization varies greatly. The principal sulphides observed are pyrite and molybdenite. Bismuth telluride has also been reported. Values in gold and silver may be associated with the pyrite. In 1934 shipments of sorted ore totalling 91 tons averaged 0.618 oz. gold per ton and 0.4 oz. silver per ton. In general the veins cut the formation, but in the surface showings some quartz appears to have developed along the bedding-planes of quartzite.

The property has been prospected by three adits, of which No. 1 at 3,865 feet elevation and No. 2 at 3,800 feet elevation are old workings. Prior to 1900 the property had been equipped with a 10-stamp mill. Probably the stoping above No. 1 level was done at that period. Subsequently the Crown-granted claims reverted to the Crown. In 1933 a private company acquired the two claims and fourteen locations staked around them. Surface prospecting was done and some 52 tons of ore of varying grade was shipped from the surface workings to the smelter at Trail. The 91 tons shipped in 1934 came from an underhand stope below No. 2 level. In 1935 the property was acquired by the present company and No. 3 level, 120 feet below No. 2, was started. Some diamond-drilling was done on this level in the spring of 1936. After a shut-down of several months in the summer work has been resumed recently. The property is equipped with a bunk-house having accommodation for about twenty men and with a Sullivan 320-cubic-foot compressor driven directly by a Ruston Diesel engine.



Waneta Gold Mines, Ltd. Plan of Workings on Bunker Hill Group after Company's Plan.

Near the portal of No. 2 level a number of open-cuts and a short adit expose a quartz vein or veins of northerly strike and easterly dip. There is some evidence of faulting. The quartz is varyingly mineralized and contains some molybdenite and fine-grained pyrite. The width of quartz varies from 1 to 5 feet.

Quartz in the three adits, in cuts north of No. 1 portal, and in a cut some 500 feet north-east of the portal marked "Blue Quartz Vein" on the plan may all belong to one vein, which varies greatly in width, is much faulted, and in general strikes east to west and dips at from 23 to 45 degrees to the south.

About 200 feet south-easterly from the last-mentioned cut is a long cut running somewhat south of east, following a fracture which crosses the contact between quartzite to the west and granite to the east. This fracture dips to the north at about 30 degrees. It is weaker in the quartzite than in the granite, being but a mere crack 20 feet west of the contact. In the granite there is from 1 to 3½ feet of quartz irregularly mineralized with molybdenite, pyrite, and some fine black sulphide. This quartz is reported to carry spotty gold values. Some 50 tons of rather low-grade material shipped in 1933 was reported to come principally from this cut. Two hundred feet to the north is a large stripping showing poorly-mineralized quartz 3 feet thick, apparently developed along the bedding-planes of the quartzite.

The "Blue Quartz Vein" in the open-cut has a thickness of 3 to 8 inches and dips at 45 degrees to the south. The foot-wall is of light-coloured quartzite, while the hanging-wall is somewhat argillaceous quartzite. There is a marked difference between the attitudes of the bedding-planes in the two walls. It is reported that 2.2 tons of ore shipped in 1933, which averaged 0.51 oz. gold per ton and 0.4 oz. silver per ton, came from this cut.

Open-cuts north of No. 1 portal expose slightly mineralized quartz 5 feet thick. In a stope which is caved to the surface similar material can be seen and there is evidence of faulting. At the portal of No. 1 level is a showing of quartz about 3 feet wide. This is cut by a lamprophyre dyke 20 feet from the portal. Beyond the dyke quartz can be seen for 60 feet behind lagging. The vein is apparently crushed here and might be regarded as drag. Some of the quartz is very rusty and was found to yield fine free gold on panning. Stoping above the drift ends at about 125 feet from the portal. Near the end of the stope on the hanging-wall side of the drift quartz is exposed. A sample across the width, 2.2 feet, assayed: Gold, 0.14 oz. per ton; silver, 0.4 oz. per ton. Beyond the stope the drift appears to be in the foot-wall of the vein for 75 feet, at which point quartz shows in the south wall in contact with a 2-foot dyke of granite. The drift continues south-easterly, at 75 feet encountering a 20-foot decomposed lamprophyre dyke containing rounded boulders of granite. Beyond this the drift continues easterly for about 125 feet, exposing a little quartz going into the south wall 25 feet past the dyke. As much of this working is off the vein, some crosscutting in the vicinity of the dykes is indicated.

No. 2 level is apparently north of the vein to 140 feet from the portal, where it encounters well-mineralized quartz from 3 to 5 feet thick, dipping at about 23 degrees to the south. Bounded by a fault on the east and apparently pinching to the west, this quartz was stoped 18 feet along the strike and below the drift for about 30 feet down the dip. The 91 tons of ore shipped in 1934 is reported to have come from this stope. The quantity shipped would be about half the computed vein volume in the ground stoped. Above the stope a raise goes through to the surface in faulted ground. East of the stope the ground is faulted and there are some lamprophyre dykes. A drift swings to the north for 50 feet, following some quartz. Thence it turns north-easterly through a fault and follows quartz, of good width but poorly mineralized, for about 50 feet farther, at which point there is another fault. The drift continues off the vein to the face 30 feet north-east.

No. 3 level starts in argillite containing some limestone-beds. It is driven easterly along a projected course of the vein. A vein was encountered at about 950 feet from the portal, where some quartz comes in from the south wall at a fault. Apparently the vein east of the fault is displaced slightly toward the north. The walls here are of quartzite. The vein has been followed east for 65 feet to another fault. Its width varies from 4 feet to a few inches and may average 1½ feet. In general the quartz is well mineralized with pyrite. A sample across 3 feet of well-mineralized quartz assayed: Gold, 0.20 oz. per ton; silver, 0.4 oz. per ton. The working continues for 30 feet, cutting through a granitic dyke about 4 feet thick but not encountering any vein-matter. A diamond-drill hole was drilled north-easterly from the end of the drift, but no other effort has been made to locate the vein.

At the point where vein-quartz was first encountered a crosscut has been driven north 25 feet along the fault. To the south-west a drift has been driven about 50 feet, following the quartz, which in 15 feet pinches from 4 to 2 feet in width. Beyond this point it pinches still further and is little more than a crack-filling at the face.

A raise inclined at 50 degrees has been put up to the south from the main adit, some 65 feet west of the place where the vein was encountered. The raise crosses a fault about 50 feet above the level. A little nearer the portal some diamond-drilling was done to test the walls, but yielded no results of interest.

It is apparent that faulting is a problem at this property and that all work must be skilfully directed if wasted work is to be avoided. Further surface cutting to prospect the northerly-trending vein or veins near the portal of No. 2 adit, and possibly to determine the downward extension of the "Blue Quartz Vein," might yield results of interest without large expense. Some carefully-directed work underground would also appear to be justified.

Paulson Area.

The ridge between McRae Creek and Big Sheep Creek, which forms the boundary between Trail Creek and Grand Forks Mining Divisions, east of Paulson, consists generally of a rolling surface from which the westerly and south-westerly slope to McRae and Coryell Creeks is quite steep, while the easterly slope to Big Sheep Creek is precipitous. The eastern side of the ridge is deeply cut by Iron and Bonanza Creeks, which flow through canyons to join Big Sheep Creek. Much of the area has been burned over, but some timber remains in protected sections. In general rock-exposures are good, though at some points there is a considerable thickness of overburden.

Paulson is a flag-station on the Kettle Valley Railway 19 miles northerly from Cascade. It may also be reached from Cascade by road which from Alpine Lodge to Paulson is narrow and winding. From Paulson a fair road 5½ miles long leads to the *Inland Empire* camp, approximately at 5,100 feet elevation. The road crosses the railway about three-quarters of a mile from Paulson, approximately at 3,640 feet elevation, then follows up Walker Creek. From the *Inland Empire* camp a branch road, now in poor condition, goes south and westerly to the *Albion No. 2* workings, a distance of approximately 1 mile, and from that point a trail runs westerly to claims on the McRae Creek slope. From a point on the main road near the *Inland Empire* camp a narrow road, generally at easy grade, leads to the *Cascade-Bonanza* workings on Iron Creek, a distance of about 2½ miles. From a point on this road about half a mile from the main road a trail goes to the old "Huckleberry" cabin on the *Enterprise* claim.

In this area work has been done at various times over many years. References to work on the *Inland Empire* group and other properties appear in Annual Reports of the Minister of Mines from 1905 on. It is reported that work had been done from some time prior to 1905. A considerable number of claims which have been Crown-granted are shown on Reference Map 11T269, issued by the Department of Lands.

A stamp-mill equipped with concentrating-tables was built for the *Inland Empire* property about 1912, and treated, according to official records, 3,520 tons of ore from the mine. Recovery, including concentrates shipped to the smelter at Trail, amounted to 60 oz. gold and 1,853 oz. silver, which obviously was not an economic operation. However, from the near-by *Berlin-Alice L.* group shipping-ore was produced amounting to 208 tons, containing 663 oz. gold, 3,072 oz. silver, and 1,247 lb. copper. Shipments were also made from the *Cascade* and *Bonanza* workings, reference to which appear below. The Annual Reports also mention shipments of the mixed sulphide ore from the *Enterprise* claim, though there appears to be no official record of the shipments. Work in the area has been sporadic and of recent years very little has been done.

The area was mapped geologically on the West Kootenay Sheet of the Geological Survey at 4 miles to the inch, published in 1904. In general the northern part of the area is mapped as Nelson Granite, containing tongues and isolated remnants of the Rossland Volcanic group occupying the central part. To the south the Rossland Volcanics are in similar relationship with the Rossland Alkali-Granite and Syenite.

From the *Inland Empire* and *Berlin-Alice L.* groups southerly to Iron Creek the exposures are of granitic rocks, but on the south side of Iron Creek the rocks exposed are greenstones of

the Rossland Volcanic group. There is also an area of greenstone to the west. Especially in the vicinity of Iron Creek there are numerous wide dykes, usually porphyritic, and varying considerably in composition, but apparently dominantly syenitic. Farther east the ground covered by the *Enterprise* group appears to be largely underlain by limy greenstone of the Rossland Volcanic group, including tuff and probably sediments. North of this section the rocks are granitic with large feldspar phenocrysts.

These rocks are cut by a series of shears or fissures which have a north-south strike and generally dip steeply. Quartz veins or lenses varyingly mineralized with sulphides of iron, lead, zinc, and copper occur in the shears. The sheared wall-rock in places is mineralized. With the sulphide mineralization values in gold and silver may occur. On the *Enterprise* claim at one point some work was done on irregular mixed sulphide mineralization, apparently representing replacement of the greenstone, or possibly of included sediments, along fractures.

The shipments from the *Berlin-Alice L.* and *Cascade-Bonanza* and sampling of certain other occurrences indicate that the shears contain mineralization of attractive grade. As mentioned below, in a number of cases the shears are found on the surface in shallow draws, particularly on the group sloping south to a tributary of Iron Creek. It is not improbable that shearing extends for considerable distances. The work to date is insufficient to demonstrate the relationship of the shallow draws to the shears or the frequency of quartz-lenses in the shears. There are some indications that the lenses are not large and faulting has been encountered. However, the grade of mineralization indicated and the possibility of prospecting with shallow workings in a reasonably accessible area are quite attractive features.

The more extensive workings on the *Inland Empire* and the *Berlin-Alice L.* groups were largely inaccessible in June of 1936, being filled with water or blocked and unsafe because of caving. The shafts on the *Amazon* claim, south of Iron Creek, were full of water and the workings on the *Enterprise* claim largely inaccessible. The smaller workings were in general more accessible, though cuts were partly sloughed in and shafts or pits partly filled with water. References to the various properties appear in the Annual Reports of the Minister of Mines from 1905 onward. In particular from 1917 to 1926 there are reports by P. B. Freeland, then Resident Engineer for the adjoining district to the west, concerning workings now inaccessible. Bulletin No. 1, "Lode-gold Deposits of British Columbia, 1932," and the Annual Report for 1932 contain further notes. The writer examined surface showings and the accessible workings in June of 1936, upon which examinations the following descriptions are based:—

Lying south of the *Inland Empire* and *Berlin-Alice L.* groups and north of the *Dubrovnik* and the *Cascade-Bonanza* group are the *Duluth*, *Albion Fraction*, and *Albion No. 2*, Crown grants of 41.81 acres combined area, owned by J. Kloman, of Paulson, who also owns the *U.S.* and *B.C.* Crown grants farther west and two near-by locations, as well as the *Amazon* lying south of the *Cascade-Bonanza* group and the *Bonanza No. 2*, a Crown grant east of the *Dubrovnik*.

Duluth. From a point near the south boundary of the *A. and G.* claim, half a mile from the *Inland Empire* camp, on the narrow road leading to the *Albion No. 2* workings, there are three cuts on the gentle rise to the south of the road. At 300 feet from the road is an outcrop of somewhat rusty quartz, 4 feet wide, which strikes north 15 degrees west and dips 70 degrees to the east. The wall-rock is granitic, light-coloured, and medium-grained. Extending southerly across the *Duluth* claim to the *Dubrovnik* claim is a well-marked depression in which the vein is exposed in cuts for about 100 feet; it appears to be much narrower at the southern end; 50 feet farther south there is a cut and small winze which was full of water. On the dump some basic dyke-rock was observed. The vein-width at the collar was not clearly indicated, but appeared to be about 4 feet, containing some well-crystallized pyrite. At this point the strike appears to be north 10 degrees east and the dip 70 degrees to the west.

Albion Fraction. Westerly from the *Duluth* winze is a parallel shallow draw, and in it a winze reported to be 12 feet deep. Water was within a few feet of the top, where there is a width of about 7 feet of quartz, reported to be narrowing somewhat going down. On the dump is a good deal of quartz fairly well mineralized with pyrite. This is near the crest of a low ridge which slopes off at about 10 degrees to the south.

Albion No. 2. On the *Albion No. 2* claim, about 1,000 feet westerly from the *Albion Fraction* winze, there is a shaft at approximately 5,700 feet elevation. A vein is traced by a cut from 40 to 75 feet north of the shaft and by an adit extending 20 feet north from the end of the cut. They expose shearing over a width of 6 to 8 feet. At the adit-portal there is 2½ feet of quartz on the west or foot-wall side. At the face there is 2 feet of quartz, well banded with pyrite on the foot-wall side. On the hanging-wall side of this quartz there is sheared granitic rock containing small lenses or stringers of quartz mineralized with pyrite. The shearing here strikes north 10 degrees west and dips 65 degrees to the east. A sample across the 2-foot foot-wall section assayed: Gold, 0.39 oz. per ton; silver, 0.6 oz. per ton; the next 2.75 feet assayed: Gold, 0.09 oz. per ton; silver, 0.1 oz. per ton; and 1.25 feet at the east side assayed: Gold, 0.04 oz. per ton; silver, trace. The outcrop has been traced northerly up the slope for about 200 feet, crossing the line into the *Alice L.* claim, to the top of the gentle southerly slope. On the northern slope soil is considerably heavier. An adit, now caved, is reported to have been driven through 90 feet of surface wash and to have gained 40 feet of depth, connecting with the bottom of the shaft about 200 feet from the portal, at which point the quartz had pinched down to a narrow seam.

U.S. About 2,000 feet west of the *Albion No. 2* workings are some workings on the *U.S.* claim. The country here slopes off rather steeply to the west or south-west and is timbered with small tamarack and balsam. A 12-inch quartz vein has been traced 40 feet northerly. At the north end is a shaft reported to be 20 feet deep sunk on the dip of the vein. The shaft was full of water to within 8 feet of the surface. At the shaft the vein is disturbed and accompanied by 3 or 4 feet of shattered wall-rock that contains some quartz and is quite rusty. A sample across 12 inches of vein assayed: Gold, 0.06 oz. per ton; silver, trace. The collar of the shaft is at about 5,250 feet elevation; the vein strikes 20 degrees west of north and dips 65 degrees to the east. The foot-wall is fine-grained greenstone, while a short distance to the east (hanging-wall) there is an exposure of granitic rock. Northerly 20 feet from the shaft a tight vein is exposed, possibly following the contact, and 100 feet northerly from the shaft is a cut exposing 15 inches of sheared granitic rock. On the dump is some quartz with epidote. The shearing strikes north 20 degrees east and dips 60 degrees to the east.

An adit has been driven north 80 degrees east from a point approximately 110 feet at south 70 degrees west from the shaft. At about 120 feet from the portal the working intersects a vein-segment lying between two faults of low dip to the west. The faults appear to be normal, with displacement of possibly 3 or 4 feet. The vein consists of rather white quartz. Drifts extend north and south for 25 or 30 feet. In the face of the south drift there is 2 feet of crushed, rusty greenstone.

Dubrovnik. This claim, owned by Smith Curtis, of Rossland, is adjoined on the north by the *Duluth, Albion Fraction,* and *Albion No. 2.* From the cut and winze on the *Duluth* claim a shallow draw extends southerly into the *Dubrovnik* claim, running down toward a small creek. Here the creek flows easterly, but a little lower down it turns to a south-easterly course to Iron Creek. In the draw at a point about 700 feet north from the creek is a partially-filled cut exposing a quartz vein about 29 inches wide at the widest, and narrowing to the north. It strikes about north 15 degrees east and dips 70 degrees to the west. At the south end the vein appears to be faulted. The quartz is mineralized with pyrite; a sample across the wide section assayed: Gold, 0.11 oz. per ton; silver, 0.1 oz. per ton.

Another draw to the west extends southerly at a moderate slope from the winze on the *Albion Fraction* to the above-mentioned tributary of Iron Creek. At points about 250 and 350 feet south are open-cuts exposing some quartz on the general strike of the vein at the winze. About 1,200 feet south from the winze, on the projected strike, an adit was driven north from the creek and another was driven south; both are caved. Forty feet above the adit on the south bank is a cut exposing 2 feet of quartz striking north 10 degrees west and dipping vertically.

Cascade-Bonanza. The Crown-granted claims, *Royal Kangaroo, California, Cascade, Bonanza No. 3,* and *Our Hope,* belong to the estate of the late H. A. Arnold, for which Robert J. Clegg, of Rossland, is the administrator. The claims have a total area of approximately 201.5 acres. They lie south of the *Albion*

No. 2 and the *Dubrovnik* claims extending roughly to Iron Creek, while the *Bonanza No. 3* and *Our Hope* lie principally south of Iron Creek.

On the steep slope north of Iron Creek is a shaft with no timbers remaining at the top. At the surface there is about 2½ feet of vein, while 25 feet down there appears to be about 6 feet of rusty shearing containing quartz. From a point near the creek about 100 feet lower, approximately at 5,100 feet elevation, is an adit driven northerly for about 450 feet. The first 80 feet is driven north 20 degrees east to shearing in granitic rock, which is then followed in a direction generally west of north. The shear is less definite at the inner end; here a crosscut to the north-east exposes some shearing a few feet from the main drift. From 125 to 225 feet from the portal the vein has been opened for stoping, and the stope is connected with the shaft from the surface. Official records show production from the *Cascade* claim in 1902 amounting to 396 tons, containing 293 oz. gold and 683 oz. silver. The shearing contains quartz-lenses varying considerably in width and in degree of mineralization. In the roof of the stope is about 15 inches of quartz, of which 4 inches along the foot-wall is mineralized with pyrite and galena. A sample across the full width assayed: Gold, 0.04 oz. per ton; silver, trace. The vein has been faulted slightly at several points, and is also cut by basic dykes, which occupy a good deal of the shear or fissure. From the south side of the creek, at a point approximately 120 feet lower, an adit has been driven at south 10 degrees east for about 200 feet, following 2 feet of shearing to about 130 feet, beyond which there is a tight seam. The drift ends at a mica dyke. Up to one-third of the shear is occupied by stringers or lenses of quartz fairly well mineralized. At 60 feet from the portal is a winze which was full of water. From 85 to 130 feet there has been stoping above the drift. Official records show shipments from the *Cascade* claim in 1905 amounting to 76 tons, containing 45 oz. gold and 683 oz. silver.

Enterprise Group.

The Crown-granted claims, *Enterprise, Huckleberry, Eureka, King Peter, Lucky Peter, Corbin,* and *Norway Star*, owned jointly by Agnes Holms, of Rossland, and George Elmes, Charles Hodgkinson, and John Schewchuk, of Corbin, are situated east of the *Inland Empire* group, on ground extending to the deep canyon of Big Sheep Creek. The ruins of the *Huckleberry* cabin are situated not far west of the canyon-rim and are reached by a branch trail about six-tenths of a mile in length, extending south-easterly from the road to the *Cancade-Bonanza* group. The rock-exposures consist of greenstone and included impure tuffs. About 1,500 feet south-south-east from the cabin is an adit on the *Huckleberry* claim at 4,750 feet elevation. The adit is driven 215 feet at about south 60 degrees west in limy sheared greenstone. At 140, 175, and 190 feet from the portal are drifts. The first follows a vein striking north 30 degrees west and dipping 65 degrees to the east for 15 feet north and 40 feet south of the adit. The vein is narrow in the face of each drift and attains a maximum width of 2½ feet of slightly-mineralized quartz in the south drift. The next drift extends 40 feet at south 15 degrees east on shearing which dips 70 degrees to the west. It shows little vein-matter. The third drift extends 40 feet at north 15 degrees west, following shearing dipping 70 degrees to the east and showing 6 to 8 inches of quartz. At the face is a winze. To the south shearing has been traced for 60 feet. From 10 to 30 feet there has been some stoping to about 15 feet above the level for a width of about 2½ feet.

On the *Enterprise* claim, 500 feet northerly from the old cabin, there is a shaft and an old adit. These workings are inaccessible. On the dump is a quantity of mixed sulphides of iron, lead, zinc, and copper. The 1926 Annual Report of the Minister of Mines mentions a sample of the sulphides assaying: Gold, trace; silver, 10 oz. per ton; lead, 16 per cent.; zinc, 20 per cent.; copper, 3 per cent. These sulphides appear to have been developed irregularly along some fracturing in the altered greenstone.

Castleton.

The *Castleton* is held by G. W. Fletcher, of Spokane, as a located mineral claim. It is reached by trail approximately three-quarters of a mile northerly from the old *Huckleberry* cabin. The workings are on the south side of Bonanza (Griswold) Creek, about a quarter of a mile west from its confluence with Big Sheep Creek. From 500 feet north of the workings on the *Enterprise* claim the formation is apparently a porphyritic granodiorite containing phenocrysts of feldspar. The workings in the same rock consist of a shaft about 20 feet deep on a narrow fracture, and 50 feet lower at

4,150 feet elevation an adit, reported to have been driven in 1912. The adit is driven southerly from a point about 60 feet above the creek. At 35 feet from the portal the adit intersects a narrow and variable fracturing dipping steeply to the west, which is followed for 75 feet. The fracture contains quartz, mineralized with pyrite and chalcopyrite, and is cut and disturbed by both basic dykes and fault-slips. At the face, in the roof, there is 6 inches of vein-matter, but below a flat-dipping slip there is no vein-filling. The vein, in a distance of 12 feet back from the face, increases from 6 inches to 1 foot wide. A sample of this section of the vein assayed: Gold, 0.10 oz. per ton; silver, trace. Another sample consisting of 11 inches of quartz taken at the west side near the floor about 50 feet from the portal assayed: Gold, 0.90 oz. per ton; silver, 0.9 oz. per ton; copper, 0.5 per cent.

LODE GOLD IN THE UPPER SPILLIMACHEEN AREA.

This report is concerned with Vermont Creek, a tributary of Vowell Creek (South Fork), with the country drained by Bobbie Burns Creek (Middle Fork), tributaries of the Spillimacheen up-stream from their confluence, and with the country at the head of McMurdo Creek, a northerly-flowing tributary of the North Fork of Spillimacheen River.

The positions of the principal points of interest and of trails are shown on the sketch-map accompanying the report on the Spillimacheen-Bugaboo area, under "Silver-Lead-Zinc Deposits." Information concerning means of access, the general topography and geology of the area is also contained in that report.

Much of the work in the area has been done on mineralization considered to be of the silver-lead-zinc type, which occurs both in veins and as replacements in limestone. Considerable pyrite occurs with this mineralization on Vermont Creek, while at the *Crown Point* group some arsenopyrite occurs. In general it appears that the replacement deposits in the area, although carrying good silver values for that type of mineralization, do not carry appreciable values in gold. On the other hand, vein-mineralization may carry fair values in gold along with silver, lead, and zinc, as indicated by the assays of samples listed below:—

Gold.	Silver.	Copper.	Lead.	Zinc.	Locality.
Oz. per Ton.	Oz. per Ton.	Per Cent.	Per Cent.	Per Cent.	
0.36	11.0	.....	23.3	0.2	"C" workings, *Crown Point* group.
0.34	3.6	Trace	10.6	.....	Ruth Vermont Mines, Ltd.
0.12	21.6	0.2	24.8	2.0	Ruth Vermont Mines, Ltd.
0.10	32.0	.....	18.8	14.4	*Ruth* claim, Galena Syndicate.
0.14	29.0	Trace	35.1	1.6	*Ruth* claim, Galena Syndicate.
0.30	2.0	Trace	Trace	0.7	*Ruth* claim, Galena Syndicate.

The last sample listed is from a vein mineralized with pyrite and arsenopyrite. The deposits from which the above samples were obtained are described more fully in the reports on the area under "Silver-Lead-Zinc Deposits."

It would appear that some values in gold were obtained at the *Alpha* group in International Basin and probably from some other prospects in the area. Precise descriptions of most of these prospects are not obtainable in the printed records.

Discoveries in the area drained by Bobbie Burns Creek (Middle Fork of Spillimacheen River) were made prior to 1890. The claims in Bobbie Burns Basin are reported to have been staked from 1881 to 1887. In 1891 a stamp-mill was packed in and the property was operated by the then Bobbie Burns Company. This operation appears to have been unsuccessful, doubtless due in part to the fact that the values were not recoverable by amalgamation. Work was done at several properties up to 1900 and a number of claims were Crown-granted. There was little activity on Bobbie Burns Creek from 1900 to 1922, when some work was done on the *Alpha* group in International Basin. The country was essentially dormant again until 1934, when the workings on the old *Flying Dutchman* claim, below the old mill-site, were cleaned out. Reference to the history of properties on McMurdo and Vermont Creeks appears under "Silver-Lead-Zinc Deposits."

In the softer rocks of the area at numerous places there are masses and veins of quartz or quartz and calcite, which frequently contain fragments of schist, and usually are mineralized only with occasional small patches of siderite, possibly containing some pyrite. The irregular masses are apt to terminate abruptly, though veins may run off from them in the schist. The large masses of white quartz frequently stand out prominently on the steep slopes.

Quartz veins of varying widths may cut the schists or follow the schistosity. They occur also in quartzite. Commonly the quartz is unmineralized and carries no appreciable values. However, some of the veins and irregular masses show better-mineralized sections and these usually carry fair values, but it appears that some quartz, although fairly well mineralized with pyrite, does not carry gold.

Crown Point Group.

The *Rialto* workings of the *Crown Point* group, about half a mile south of the camp, explore by drifts and a short winze a series of quartz-lenses and irregular veins occurring, in a width of 20 feet, in sheared, grey, splintery schist. Probably mineralization containing some values in gold was found, but in general the quartz contains little sulphide mineralization. Along the west wall of the adit-drift is a rusty streak containing some pyrite. A sample of this material assayed: Gold, trace; silver, 0.4 oz. per ton.

South of the "A" workings of the *Crown Point* group is a mass of quartz in grey schist on the steep nose of a ridge. One strong vein about 4 feet thick can be seen striking to the north-west with the bedding. Other veins striking at various directions in the schist are irregularly mineralized with pyrite and fine-grained galena and contain streaks of rusty carbonate. Some testing has been done on one such vein which extends southerly from the large mass. The test-pits, however, have become filled with morainal material. Some work was done looking for quartz brought down by a freshet from a draw just south of the portal of "A" adit. At one point in the morainal material the writer found quartz well mineralized with pyrite and some fine-grained galena. A sample of selected well-mineralized material assayed: Gold, 0.20 oz. per ton; silver, 2 oz. per ton. Much of the quartz is unmineralized. Samples of the unmineralized quartz and of patches in the quartz containing some siderite and a little pyrite, obtained at several points in the area, indicate that such material is barren of values.

Robert E. Burns Group.

Four Crown-granted claims, *Rider, Nugget, Robert E. Burns,* and *Highland Mary,* in Bobbie Burns Basin, are owned by E. J. Scovil, of Golden. The site of the old mill, on the creek, half a mile below the workings, is also held by Mr. Scovil as real land. Farther down the creek, near the Middle Fork of the Spillimacheen, are three Crown-granted claims, *Bryan, Lincoln,* and *Lucky Jack,* also owned by Mr. Scovil. The three claims adjoin the *Flying Dutchman* location, concerning which some notes appear below.

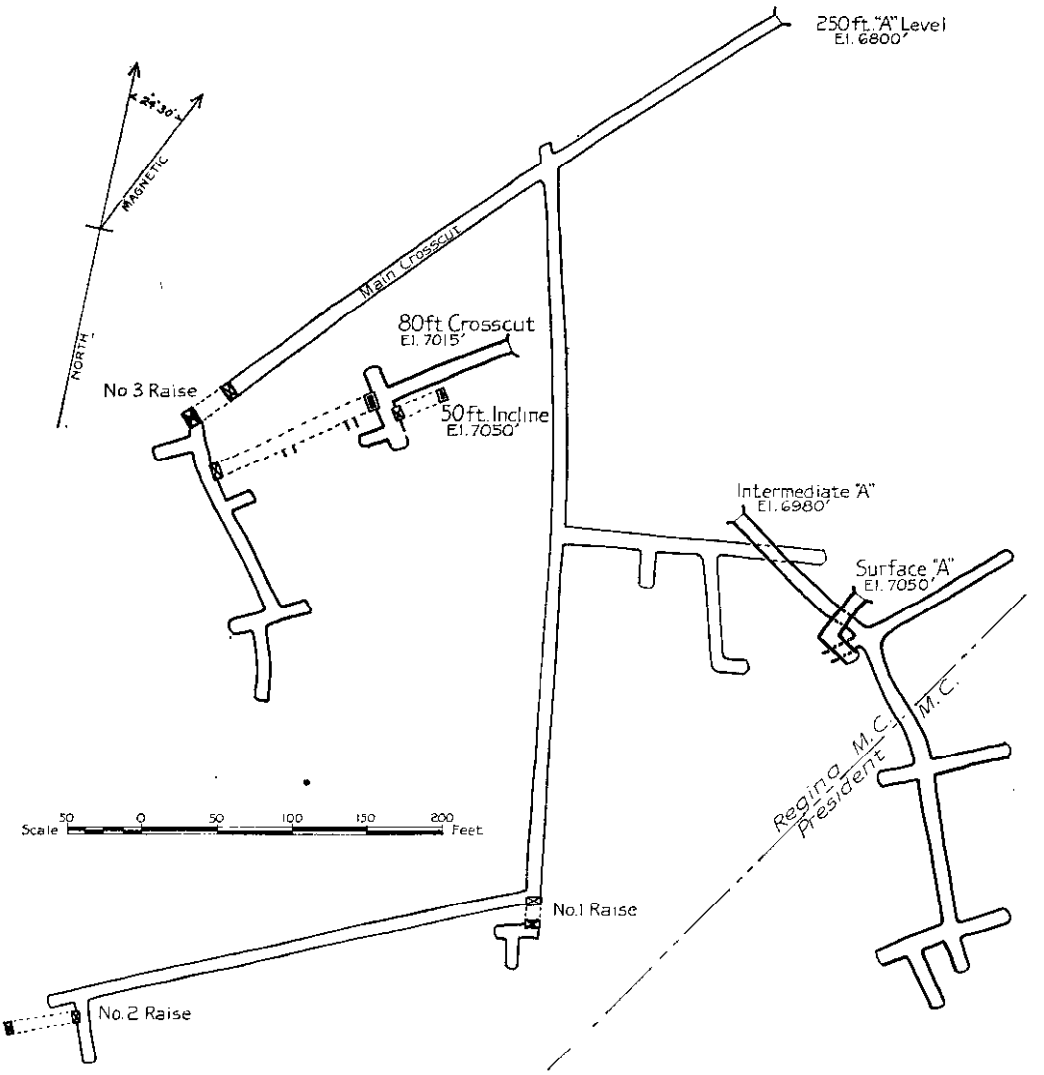
The four claims first mentioned are in the main basin, the workings being at elevations of from 7,200 feet to 7,500 feet, while the old mill, which is below the main basin, is at an elevation of about 6,800 feet. The descent from the basin to the Middle Fork is quite steep. The passes on the summit north-west of the basin, between it and the head of McMurdo Creek, are at elevations of from 8,050 feet to about 8,200 feet.

This group can be reached by pack-trail from Carbonate Landing or from Wells Landing, the distances being approximately 28 and 32 miles respectively. The trail up the Middle Fork, about 17 miles in length, is doubtless in poor repair and much grown over. The basin can also be reached from the Crown Point camp. The distance involved would not be more than 3 miles. It is necessary to climb about 2,200 feet from the Crown Point camp and to cross the snow-field, but in the summer-time the trip can be made on foot without difficulty. This route is not practicable for horses.

The rocks exposed in the rim of the basin are slates and schists, some of which are limy and contain fair-sized crystals of pyrite. The schistosity strikes west of north and dips steeply to the east. The bedding where observed is generally of low dip. A well-marked anticlinal fold can be seen to the south across the Middle Fork. Below the main basin the rock-outcrops are of quartzite or grit, which is also somewhat schistose.

At about 1,400 feet south 60 degrees west from the adit on a low ridge running southerly into the basin in a series of open-cuts. North of the cuts is a good deal of white quartz which has come from the steeper slope above. The northernmost cut is at the contact between bluish

slate on the west striking north 10 degrees west and dipping 80 degrees to the east, and on the east greenish splintery schist striking north 20 degrees west and dipping 80 degrees to the west. In the latter strong joints striking south 60 degrees west and dipping 75 degrees to the north-west are filled with wedges of quartz. The cut, which is 30 feet long, is partly filled. There seems to have been 2 feet of sparingly-mineralized quartz which at the contact at the south end of the cut follows the schistosity as a 1-foot vein, exposed for 8 feet from the contact.



Crown Point Group. Plan of "A" Workings after Owner's Plan.

About 60 feet to the south is the upper end of a cut which runs south 20 degrees east for 30 feet, following 2 feet of poorly-mineralized quartz along the cleavage of the slate. The cut then swings to south 5 degrees west for 80 feet, cutting the slate. The bedding of the slate has a flat dip to the east. The cleavage strikes north 20 degrees west and dips steeply to the east. The bottom of this cut is filled with debris. Along the side is a pile of quartz, a good deal of which is quite well mineralized with pyrite. From this the following samples were taken:—

SAMPLES.

Gold.	Silver.	Description.
Oz. per Ton.	Oz. per Ton.	
1.26	0.2	Selected crystalline pyrite in white quartz.
1.66	0.4	Selected rusty honeycombed quartz.
0.02	Trace.	Selected quartz free from sulphide or rust.

These samples strongly suggest that the gold is associated with the pyrite and that the unmineralized quartz is barren. Two earlier reports have given values in iron pyrite at 0.8 and 1.36 oz. gold per ton. The report by B. T. O'Grady in the Annual Report of the Minister of Mines for 1923 mentions sampling a pile of ore at the old mill. Two splits from a large sample assayed: Gold, 0.30 oz. per ton; silver, 1 oz. per ton; and: Gold, 0.28 oz. per ton; silver, 0.4 oz. per ton.

About 500 feet to the south is the remains of an old cabin. Between 80 and 200 feet south of the cabin are three cuts exposing an almost unmineralized quartz vein 1½ feet wide following the strike of the schistose grit, which forms a low ridge. A little rust, pyrite, and some copper-stain were noted. A sample of this material assayed: Gold, trace; silver, trace. The old stamp-mill is about half a mile farther south below the junction of two streams. It is now in a ruinous condition.

Flying Dutchman.

The following is quoted from the 1934 Report by B. T. O'Grady, under the heading "Burns Basin Gold Mines, Ltd.": "The property with which this company is concerned includes the *Flying Dutchman* and seven other claims, all being held by location. . . . The claims cover the steep slope adjoining the small creek which drains Robbie Burns Basin in an old burned-over area which is now covered with scattered second growth. . . .

"Exclusive of the old *Flying Dutchman*, which is a relocation, the claims constituting the company's property were staked by agents on October 6th, 1934, after previous stakings by the same representatives, found to be irregular, were abandoned. The *Flying Dutchman*, as also the *Robert E. Burns* group, with which this report is not directly concerned, were described by the late W. Fleet Robertson in the Report of the Minister of Mines for 1898. No mining has been done in the immediate area since then. The only development done on the property of the Burns Basin Gold Mines, Limited, is on the *Flying Dutchman* claim, where two adits were driven in the nineties on separate quartz-exposures. The upper adit, at an elevation of 6,350 feet, is a crosscut driven north-westerly for about 115 feet. At 23 and 30 feet in from the portal 12-inch quartz stringers are cut which strike north 80 degrees east and dip at 38 degrees to the north.

"At about 65 feet in from the portal a branch working 24 feet in length cuts a lens of quartz up to 34 inches wide. A sample at this point gave no appreciable values in gold and the two quartz stringers previously mentioned showed no evidence of mineralization. The lower adit, at an elevation of 6,125 feet, is a crosscut driven north-westerly for about 65 feet to its intersection with a quartz vein, tightly frozen to the wall-rock, which strikes about north 60 degrees east and dips at 60 degrees to the north-west. A curving drift 60 feet long exposes short sections of the vein, 20 to 36 inches wide, at opposite extremities of this working, the central section being left in the south-eastern wall of the adit. A sample at the south-western face assayed 0.46 oz. gold per ton across 21 inches. Samples at the opposite face were: Across 36 inches, which assayed 0.04 oz. gold per ton; and the same section, in two cuts 24 and 12 inches wide, which assayed respectively: Gold, *nil*, and 0.06 oz. per ton. The latter cut on the hanging-wall side was heavily mineralized with pyrite, the assay results indicating erratic gold content in the iron sulphides."

SILVER-LEAD-ZINC DEPOSITS.

PEND D'OREILLE RIVER AREA.

Red Rock Group.

Seven located mineral claims, *Red Rock, White Rock, Blue Rock, Green Rock, Marjorie, Mary Lou*, and *Cabin Fractional*, are held by Michaely Silver Lead Mines, Limited, a private company, of which N. Michaely, of Rossland, is president, and L. A. Read, of Trail, is secretary-treasurer. The claims are situated north of Salmo River, about 2 miles north-east from its confluence with the Pend

d'Oreille, in the Nelson Mining Division. A branch road which leaves the Nelson–Waneta Highway at a point about 6 miles from Nelway climbs approximately 1,400 feet in 3¼ miles to the camp at 3,200 feet elevation. The distance from the smelter at Trail is approximately 28 miles by road. The country slopes steeply to the Salmo River, and in most places overburden is heavy. In the vicinity of the workings there are fair outcrops.

The workings are situated close to a north-easterly-striking, faulted contact between impure quartzites on the north-west, with limestone, argillites, and quartzites on the south-east. These rocks are mapped by Walker (Geological Survey Memoir 172, Salmo Map-area) as Reno series and Pend d'Oreille series respectively. The contact has a general north-easterly trend, but it is irregular and there has been adjustment of the rocks along numerous slips and shears close to the contact. As a result the attitude of the interbedded limestone and quartzite south-east of the contact varies considerably, though the general strike is about north-east and the dip 50 to 70 degrees to the south-east.

Sulphide mineralization is developed in shears and replacements in the limestone. Some lenses of almost solid sulphides occur close to the faulted contact, with more or less disseminated mineralization in the vicinity of the lenses. The mineralization consists of sulphides of lead, zinc, and iron, carrying moderate values in silver.

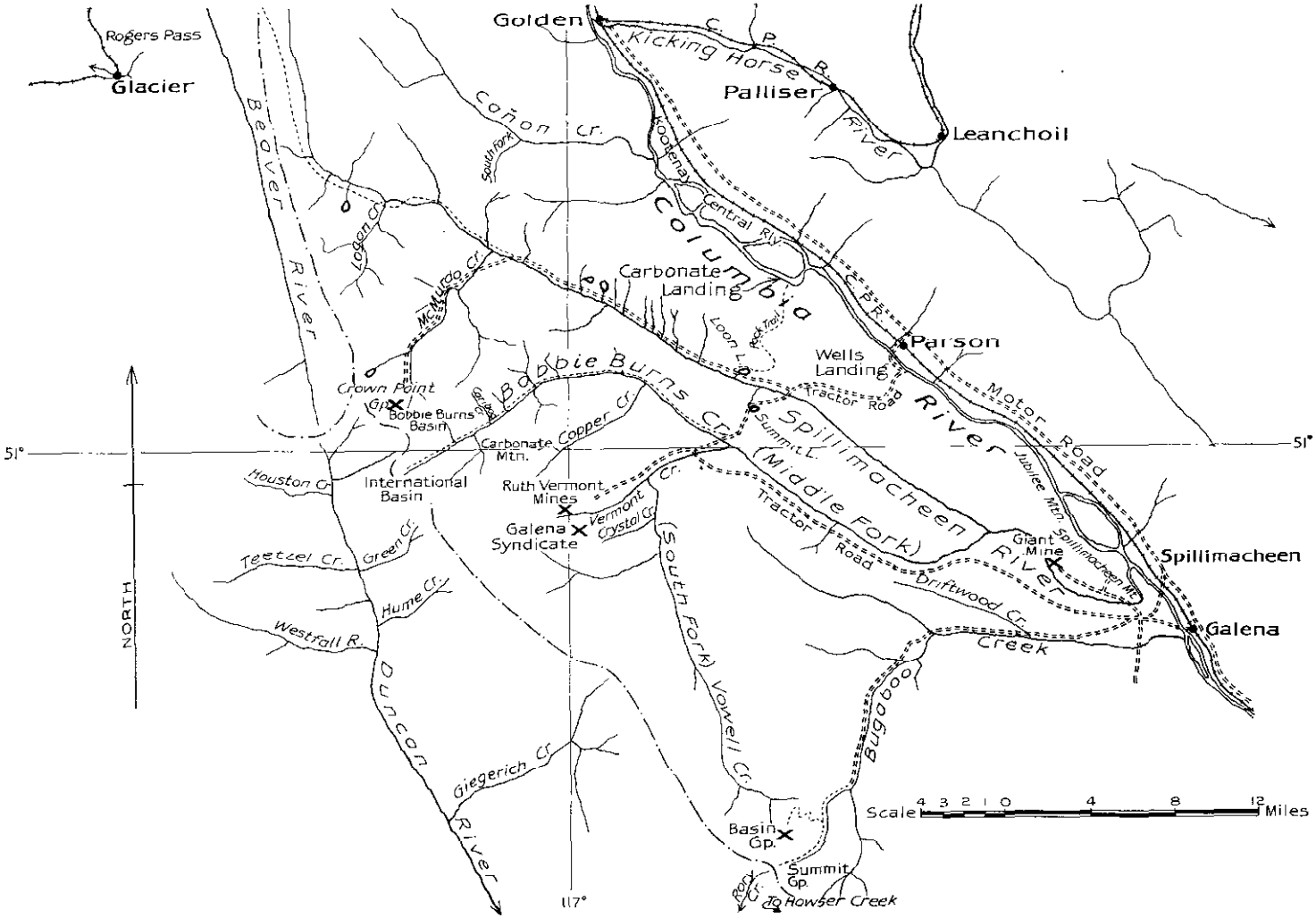
The property was located in 1928 and after some development by other interests was acquired by the present company in 1932. In addition to strippings and surface cuts, the property has been prospected by four adits, of which the lowest was in 80 feet late in June. In 1935 selectively-mined ore totalling approximately 35 tons, averaging 14.9 oz. silver per ton, 28 per cent. lead, and 16 per cent. zinc, was shipped to the smelter at Trail. In 1936 shipments amounted to approximately 60 tons, averaging 9.6 oz. silver per ton, 19.5 per cent. lead, and 20.5 per cent. zinc.

"A" adit at 3,315 feet elevation is driven 32 feet at north 42 degrees west from the end of a 17-foot rock-cut. This working cuts through limestone and limy schist, cut by several shears. At 27 feet from the portal a shear 6 inches to 1 foot wide, striking north 50 degrees east and dipping 70 degrees to the south-east, contains 6 inches of galena. A test-pit 60 feet south-west of the portal at the intersection of two shear strands, the stronger shear about 18 inches in width, contains some rusty carbonates and galena.

In a large stripping 120 feet south 33 degrees east from the portal of "A" adit is the end of a lens of massive sulphides. The lens, which is irregular in outline, extends south-west for a length of 45 feet, varying in width from 2 to 5 feet. At 30 feet from the north end a lens 1 to 2 feet wide, which for 4 feet is exposed trending due south toward the first lens, turns and parallels it about 2 feet to the north-west, extending 20 feet past the south-west end of the first lens. The width of the first lens narrows to 2 feet or less where the other approaches and parallels it. Including the two lenses there is a width consisting of the massive sulphides with some disseminated sulphides of 5 or 6 feet for 45 feet and narrower for the remaining 20 feet. The foot-wall of the north-west lens is impure quartzite. The hanging-wall is blue limestone striking north 50 degrees east and dipping 60 degrees to the south-east, though near the centre of the larger lens the limestone is warped, and at this point the lens has a wide bulge to the east. Beyond the north end there is some mineralization along narrow fractures. South-west of the lenses bed-rock is buried under overburden.

No. 1 adit at 3,297 feet elevation, 25 feet below the top of the stripping, is driven under the central part of the larger lens. It extends for 46 feet north-west from the end of a 33-foot cut. The cut and the first part of the adit are in blue limestone. The face of the adit is in impure quartzite. Mineralization consists of 4 feet of rusty shearing containing galena, and some disseminated mineralization in the limestone.

No. 2 adit at 3,242 feet elevation starts from a point 85 feet south of No. 1 portal, and goes in for about 115 feet at north 30 degrees west. At 80 feet from the portal a drift has been driven 50 feet at south 80 degrees west and another 36 feet at north 55 degrees east to a bend; thence to the face for 10 feet at north 30 degrees east. To 40 feet from the portal the adit is in quartzite; thence to just past the drifts it is in blue limestone. At 40 feet the contact is a fault which strikes north 40 degrees east and dips 67 degrees to the south-east. From 55 to 70 feet from the portal the ground is sheared and altered and contains some sulphides. On the north-east wall from 64 to 68 feet is a decomposed mica dyke which apparently does not cross the adit, but probably enters the north-east drift in faulted ground. Near the drift is solid limestone containing veinlets of sulphides.



Map of Spillimacheen-Bugaboo Area, showing Location of Properties.

At the entrance of the north-east drift there is 5 feet of massive sulphides which continues in the roof for 10 feet, where a flat slip comes in, and the ground above is much broken. From this point to the bend the roof is closely lagged. Shearing comes in to the drift from the south-east, 20 feet from the entrance, but ore continues along the north-west wall to 26 feet. Beyond this the ground contains several shear-strands. The face is in thin-bedded limestone.

The drift to the west has from 2½ to 5 feet of heavily-mineralized ore to 20 feet from the entrance, at which point the mineralization begins to narrow, as quartzite, striking south 70 degrees west, comes in from the south wall. From 12 to 18 feet is a winze which was full of water, as was the drift beyond it to a depth of a foot or so. It was reported that there is ore in the floor at the face.

No. 3 adit-portal at 3,125 feet elevation is 250 feet from No. 2 portal at south 13 degrees east. Thin-bedded quartzite outcrops on the steep hillside between the two. The portal is in black limestone. This adit is being driven north 25 degrees west. The face at 80 feet was in thin-bedded quartzite. Projected on the dips observed above, mineralization might be expected at 300 feet from the portal. However, the dip in the winze was reported to be steeper, which would increase the distance. The lens observed above may not come down to No. 3 level, but if it does not there is a fair chance that there may be another lens at no great distance from the projected position.

Spillimacheen-Bugaboo Area.

The accompanying sketch-map shows the area in the East Kootenay District drained by Spillimacheen River and Bugaboo Creek. Both streams rise in the Purcell Range and drain into the Columbia River. They enter the Columbia River Valley from the west through the same gap in the low range across from the settlement known as Spillimacheen. Spillimacheen is on the Kootenay Central branch of the Canadian Pacific Railway, and on the main highway, approximately 41 miles south of Golden.

This report is concerned chiefly with the area lying between Spillimacheen River (North Fork) and the summit of the Purcell Range, from somewhat north-west of McMurdo Creek to the head of Bugaboo Creek. The length along the crest of the Purcell Range is about 30 miles. The distance from the divide to the Spillimacheen (North Fork) varies from 10 or 12 miles at the north-west end to 19 miles at Bugaboo Creek. The area also includes the country tributary to the Spillimacheen, and Bugaboo Creek, east of the head of Bugaboo Creek, also Spillimacheen and Jubilee Mountains, which are north-east of Lower Spillimacheen, between it and the Columbia River.

Little of this area has been mapped either topographically or geologically. The principal streams, roads and trails, and the Crown-granted mining claims are shown on mineral reference maps issued by the Department of Lands; these maps, however, are rather sparing of detail. The north-west corner of the area is mapped topographically on the Glacier Park sheet, published by the Department of the Interior in Ottawa in 1934. Map 295A, "Brisco-Dogtooth Area," published by the Geological Survey, with a report by C. S. Evans in the Summary Report, 1932, Part A, shows geology without topography along the Columbia River and north of the Spillimacheen River adjoining the area. A report by John F. Walker, "Reconnaissance in the Purcell Range, West of Brisco, Kootenay District, B.C.," gives the geology along some streams in the area, also at Spillimacheen and Jubilee Mountains.

On the index map accompanying the report by Walker the country along the middle reaches of Bugaboo Creek is shown as Upper Purcell series, Mount Nelson, and Dutch Creek formations. The country up-stream is mapped as Windermere series; both series are of Precambrian age. West of the head of Bugaboo Creek, Jurassic granite is indicated. Bobbie Burns Creek as far as Warren Creek, and Warren Creek, are mapped as Windermere series. Spillimacheen and Jubilee Mountains are mapped as Palæozoic sediments. Evans's mapping of the country adjoining the area on the north-west as Windermere series suggests that the unmapped section extending from Evans's mapping south-easterly to Walker's mapping and embracing a large part of the present area may be chiefly Windermere series.

Bugaboo Creek and the principal branches of Spillimacheen River occupy broad deep valleys from their outlets at the Columbia, westerly through rolling country, and well into the Purcell Range, where their gradients and those of the tributary streams become steep between high ridges and jagged peaks. The smaller tributaries extend into basins at elevations

of from 5,500 to possibly 8,000 feet. The main ridges reach elevations of from 7,000 to 8,000 feet and rise to peaks of considerably greater elevation.

In this area west of the Rocky Mountain Trench the rocks appear to be almost entirely of sedimentary origin. They consist of schists and slates, some of which are limy, limestone, gritty quartzite, and some conglomerate. The bedding-planes, even in the schist and slates on Vermont Creek in Bobbie Burns Basin and on McMurdo Creek, are frequently easily discerned. The formations appear to have been arched in a series of folds, the axes of which strike from 20 to 50 degrees west of north. The schistosity, slaty cleavage, and some prominent jointing, in general strike north-westerly and dip steeply to the north-east. At the head of Bugaboo Creek there are numerous intrusions of granite porphyry, some of which has been rendered schistose.

On Vermont Creek there are narrow veins, usually in the slate, mineralized largely with lead and zinc minerals and carrying fair silver values. These are described in this section under "Galena Syndicate" and "Ruth-Vermont Mines." Lead and zinc replacement in limestone, in general carrying good silver values for this type of mineralization, are described under "Crown Point Group" and under "Galena Syndicate." Lead-zinc replacement in limestone carrying some copper is described under "Summit Group" in this section, under the main heading "Silver Basin Mining Syndicate."

Sulphide mineralization in barite gangue occurs on Spillimacheen and Jubilee Mountains west of the Columbia River, within a few miles of Spillimacheen. This section seems to have possibilities of producing a considerable volume of milling-ore, with values principally in lead and with moderate silver values. The mineralization occurs as lenses in the barite. The barite replaces limestone in thickness from 10 to 60 feet. Lenses of milling-ore are reported in thickness from 10 to 30 feet. The possibility of producing commercial barite as a by-product from milling lead ore is indicated in "Investigations in Ore Dressing and Metallurgy, 1926," published by the Department of Mines at Ottawa, reporting tests on ore from the Giant property. The most extensively-developed property is the Giant, 7 miles from Spillimacheen, where a test-mill was built in 1909 and where extensive development was in progress from 1926 to 1931. References to this section, including a discussion of structural features at the Giant property, appear in the Geological Survey publications listed above. The Annual Reports of the Minister of Mines from 1895 on give information concerning the various properties; in particular the reports for 1898, 1909, 1923, and from 1926 to 1930, inclusive.

There are numerous quartz-lenses in schist, and quartz veins, usually in harder rocks, many of which are practically barren. Descriptions and some general discussion of such occurrences appear in this section under "Silver Basin Mining Syndicate," subheading "Basin Group," and in "Lode-gold Deposits" under the heading "Lode Gold in the Upper Spillimacheen Area."

At several places in the area copper prospects have been located; none of them were visited by the writer. Reference to copper prospects and other prospects not mentioned here will be found in the Annual Reports of the Minister of Mines, particularly in the years 1898, 1917, 1920, 1922, and 1923.

The relative positions of various points of interest in the area and of roads and trails are indicated on the sketch-map herewith. The road from Spillimacheen to the Giant property is in quite good condition. The road up Bugaboo Creek, though somewhat rough, was passable for a truck as far as 26-Mile in the summer of 1936. The sleigh or tractor roads leading to Vermont and McMurdo Creeks from Wells Landing have been in use as pack-trails in the last few years. The pack-trail from Carbonate Landing has also been in use. The tractor-road from Spillimacheen to Vermont Creek has not been in use for some time and may be impassable. The crossing of the Columbia River at Spillimacheen is by good bridge and built-up road across the sloughs. From Parson to Wells Landing the road may be impassable during very high water. Carbonate Landing can be reached from the east side of the river by crossing a slough on a condemned bridge, impassable except for foot traffic, and by boat across the main channel. Some details concerning means of access appear in the references to various properties below.

Most of the discoveries in this area were made from 1883 to 1900, in which period numerous claims were Crown-granted, many being still in good standing, while others have reverted to the Crown. A stamp-mill was set up at the *Robert E. Burns* group in 1891 and operated for a

short time. Some ore was packed from the *Ruth* workings on Vermont Creek to Carbonate Landing prior to 1898, when W. Fleet Robertson, then Provincial Mineralogist, reported that material, which had not been sorted at the mine with sufficient care, was still lying at Carbonate Landing. The 1898 report gives a general description of a number of properties. Since 1900 the outstanding activity seems to have been as follows: In 1922 and 1923 work was done on the *Alpha* group in International Basin. There has been activity at the Giant property in 1909 or 1910 and again from 1926 to 1930. Work was done principally on the *Ruth* claim on Vermont Creek by the Galena Syndicate from 1926 to 1929. Assessment-work is being done by Ruth Vermont Mines on claims north of Vermont Creek; this company is under the same control as the Witwatersrand Mining Syndicate, which, since 1928, has been doing development-work at the *Crown Point* group on McMurdo Creek. Some work was done on the *Flying Dutchman* claim, below the *Robert E. Burns* group, by Burns Basin Mines, Limited, in 1934, while in 1935 and 1936 the Silver Basin Mining Syndicate had a crew working on the road and trail, and doing some work on two groups at the head of Bugaboo Creek. In addition to these operations, assessment-work has been done on a number of claims.

Crown Point Group.

Thirteen Crown-granted mineral claims and six locations adjoining them are owned by Witwatersrand Syndicate, Limited, a private company registered in Victoria and represented by G. W. Edwards, of Golden. These claims are situated in a large basin at the head of a branch of McMurdo Creek, a tributary which enters the Spillimacheen River from the south. The position is shown on the mineral reference maps, also on the Glacier Park sheet, issued by the Department of the Interior.

The mine camp is situated on the level floor of the basin at an elevation of 5,900 feet (from aneroid readings). This flat is about half a mile wide and extends for three-quarters of a mile down McMudro Creek. The main valley rises steeply in a direction somewhat east of south and contains a branching stream fed by a snow-field on the divide between this valley and Bobbie Burns Basin. South-west of the camp, drainage from an extension of the snow-field is by a series of cascades into a western branch of the creek. Above the level floor rock walls rise precipitously on the west and on the east and steeply to the south. The ridges surrounding this basin exceed 8,000 feet in elevation and have peaks several hundred feet higher.

The property may be reached from Carbonate Landing on the Columbia River by following the old pack-trail to the junction with the tractor-road up the Spillimacheen River. The elevation at Carbonate Landing is approximately 2,570 feet. The pack-trail in about 6 miles crosses a 4,900-foot summit and drops down to the river near Loon Lake, at an elevation of about 4,200 feet. The distance to the junction from Wells Landing is somewhat greater. A tractor-road was constructed from Wells Landing to the property in 1929, but for some years has been used as a pack-trail only. The distances are variously stated, but it would appear that from Wells Landing to the junction is about 10 miles. From the junction to McMudro Creek for about 17 miles the trail follows easy grades and there is no rock-work. From the crossing near McMudro Creek to the mine camp is about 8 miles. There is a fairly steep climb up from the river; thence the grade to the mine is fair. Some rock-work was required about 2 miles from the river where the road crosses McMudro Creek on a log bridge. From this point on to the property the road is generally in poor condition and much of it should be relocated if it were to be used as anything more than a pack-trail.

The rock-exposures above the floor of the basin are generally good, though there is a fairly dense growth of small trees at the lower elevations, and higher up much of the rock-surface is covered with morainal debris and with the snow-field. The workings are entirely on the western side of the basin. Here the rocks, although subject to some minor wavy folding, dip to the south-west east of the "A" workings, while up the hill the rocks are found dipping to the north-east. It appears that the rocks on the western side are on the south-western limb of an anticlinal fold, the axis of which strikes about north 50 degrees west. The rocks consist largely of grey schist which weathers to a mass of splinters; interbedded with the schist are impure argillites, somewhat limy, numerous beds of greenish, gritty quartzite, limestone with limy schist, some reddish slates interbedded with the limestone, and conglomerate. The schistosity, slaty cleavage, and prominent jointing in the quartzite strike generally north 50 degrees west and dip steeply to the north-east.

Replacement in limestone appears to be the most important type of mineralization. The mineralization exposed consists principally of galena disseminated through the limestone or limy schist, and as lenses which appear to follow the bedding-planes or the dominant planes of schistosity. In the vicinity of such mineralization, joints striking about south-west and dipping almost vertically are commonly quartz-filled and may contain galena. Though the most abundant mineral is galena, some sphalerite and pyrite also occur. Specimens at the portal of the 80-foot level include elongated prisms of arsenopyrite, associated with quite coarsely-crystalline galena. The following samples indicate that the sulphides carry quite good values in silver for this type of mineralization:—

Gold.	Silver.	Lead.	Zinc.	Description.
Oz. per Ton.	Oz. per Ton.	Per Cent.	Per Cent.	
Trace	1.0	2.5	9.6	Disseminated in limestone, lower Bluff.
Trace	11.4	20.8	13.3	Selected sulphide, lower Bluff.
Trace	8.0	14.8	Trace	0.5 feet at hanging wall; 80-foot crosscut level.

There is also lead-zinc mineralization in quartz veins or lenses in schist as at the " B " and " C " workings. Pyrite occurs with this type and there are values in gold. This mineralization appears to be of secondary importance. Reference to quartz very sparsely mineralized, which could be of value only for possible precious-metal content appears in another section under " Lode Gold in the Upper Spillimacheen Area."

Workings consisting of surface-stripping and adits are situated at five points. The most extensive are the " A " workings, of which a plan appears herewith. They are about three-quarters of a mile south 20 degrees east of the camp, at elevations from 6,800 to 7,050 feet (aneroid readings). The *Rialto* adit is about half a mile south 4 degrees east from camp, approximately at 6,800 feet elevation. " B " adit is a quarter of a mile south of camp at approximately 6,125 feet elevation, on the steep north-facing slope, which runs from the cascades to the main stream. Farther west on the same slope, close to the cascades, are the Bluff workings, while the " C " workings are on the north-west side of the cascade-fed stream, opposite the Bluff workings and about 1,500 feet from the camp at south 30 degrees west.

Of the " A " workings, Surface " A " and 50-foot incline are old, as are also the " B," Bluff, and " C " workings, though some work was done at the " C " workings a few years ago. Apparently the property had been inactive for many years before work by the present syndicate was commenced under G. W. Edwards in 1928. Since then most of the underground work has been done at the " A " workings and the *Rialto* adit driven in 1931 and 1932. A gasoline-powered air-compressor was used at the " A " workings in 1929, but work since then has been done by hand. References to the work in those years appear in the Annual Reports of the Minister of Mines from 1928 to 1932.

" *A* " *Workings.*—The accompanying plan shows the " Surface " A " and Intermediate " A " adits, which lie south-east of a small stream running north-easterly not far from the portals of the 80-foot crosscut and of " A " adit, also called the 250-foot level, north-west of the creek. The 50-foot incline connects with the 80-foot level, which in turn connects with a sub-level at the top of No. 3 raise from the end of the main crosscut on the 250-foot level. When the property was visited late in August, 1936, work was confined to drifting on the sub-level driven from the top of No. 3 raise.

In the vicinity of these workings the beds vary considerably in dip, due to faulting and to wavy folding along axes parallel with the axis of the major structure. Mineralization in limestone has been found in the workings on both sides of the small creek. As there has been faulting, and as there is a great deal of slide debris about the workings south-east of the creek and in the creek-bed, it is doubtful if the same beds are found in these unconnected workings.

Somewhat similar limestone-beds, which with some gritty interbeds have a total thickness of 60 feet and are impregnated with pyrite crystals, are found from 800 to 1,000 feet south-east from Surface " A " adit and 350 feet higher in elevation. Part of this thickness consists of somewhat limy argillite. These beds are apparently higher in the series than those at the workings.

The beds at the Surface " A " adit are disturbed and dip more steeply to the south-west than do those at Intermediate " A," 75 feet lower. Their relationship is obscured by slide-debris. The 50-foot incline across the creek is at about the same elevation as Surface " A," but, as mentioned above, the relationship of the beds is open to question. There is a fault in the workings east of the crosscut which runs from the main crosscut to No. 1 raise on the 250-foot level. The fault where observed has a strike of about due north and dips 45 degrees to the east. It may cross the main adit in the timbered ground near the portal. Projected upward it would lie outside the 80-foot crosscut and the 50-foot incline. Reverse faulting would be necessary for the beds at Surface " A " to correspond to those at the 50-foot incline. The exposed thickness of limestone and limy schist at the 50-foot incline is 11 feet; about 200 feet to the north-west there is an exposed thickness of 20 feet of similar limestone.

Apparently there are two and possibly three horizons in the vicinity of the workings at which considerable thicknesses of limestone and limy schist occur. Mineralization with galena, pyrite, and some sphalerite occurs in the limestone at the workings. Development to date seems to indicate that the lower contact of the limestone with grey schist is a favourable place for mineralization.

Surface " A " consists of a rock-cut from the south-west end of which an adit has been driven 25 feet at south 30 degrees west. From the end of the adit a muck-filled drift goes about south 20 degrees east. The workings are in limestone which is disturbed and broken. The beds are not well marked, but appear to strike north 50 degrees west and dip 60 degrees to the south-west. Galena, sphalerite, pyrite, and siderite occur as small lenses and as joint filling. The sulphides also occur as disseminated grains in the limestone from 8 feet outside the portal to 18 feet within. The joints, filled with mineralized calcite, strike north 50 degrees west and dip 35 degrees to the north-east.

Intermediate " A " adit is driven south-easterly for 120 feet. At the portal the roof is limestone, resting on schist, the contact showing in the walls. The beds dip about 25 degrees to the south-west and are cut at a small angle by the adit. To 60 feet from the portal the limestone is well mineralized with galena in two or three streaks, from 1 to 3 inches thick, which follow the bedding. At 100 feet from the portal the contact is at the floor. At 120 feet from the portal a crosscut to the south-west, about 25 feet long, is in limestone, and one to the north-east is chiefly in schist. No mineralization is exposed.

At the crosscuts the adit turns to a more southerly course, following shearing dipping 70 degrees to the east to the 200-foot crosscut. At 40 feet past this crosscut the mineralization is more abundant, lenses of galena being developed along the bedding, which strikes north 50 degrees west. The mineralization appears to go into the east wall 30 feet farther south. Ten feet farther is a 2½-foot quartz vein striking north 40 degrees west and dipping 50 degrees to the south-west. The quartz contains some sericite but is essentially unmineralized. It goes into the east wall of the adit, but is found again 20 feet ahead in the 300-foot crosscut, 15 feet east of the adit. The adit continues 17 feet past the crosscut, in ground which is well mineralized, containing lenses of galena up to 6 inches thick. At 12 feet from the crosscut there is 3 feet of very good ore.

The crosscut extends for about 45 feet west of the adit. At 25 feet is a drift which extends south-easterly for 38 feet. Along the east side of the drift and in the crosscut for 5 feet east of the drift there is fair mineralization. In the face there is 2½ feet mineralized with ¼-inch stringers and disseminated sulphide grains, principally of galena. The beds here strike north 40 degrees west and dip 40 degrees to the south-west. In the crosscut, 13 feet west of the drift, is a 6-inch gouge-seam striking north 50 degrees west and dipping 55 degrees to the south-west.

50-foot Incline.—This working, at about the same elevation as Surface " A," is 300 feet at north 75 degrees west from it. It was sunk from the end of a 15-foot cut, following bedded limestone resting on crumpled grey schist. The limestone, too, is somewhat crumpled and contains thin seams of sericite-schist. Near the base of the limestone a good deal of galena is developed, 3 feet being well mineralized. The intensity of mineralization is less farther from the contact. As the old timber in this winze was unsound the working was not examined below the surface.

About 35 feet below the incline is the 80-foot crosscut level. This consists of an adit about 95 feet long which follows a quartz-filled joint, dipping vertically and striking south

55 degrees west, cutting the schist, which strikes north 20 degrees west. From the end of the adit drifts go a short distance to right and to left following the contact of the schist with the overlying limestone, while a winze follows the contact down the dip at 35 degrees to the south-west. The 50-foot incline connects with the drift just south of the winze and crosscut, and a 20-foot crosscut runs south-west from a point 15 feet south of the winze. This crosscut exposes limestone mineralized for a thickness of approximately 12 feet normal to the dip. Of this section only the 6 inches at the hanging-wall—which assayed: Gold, trace; silver, 8 oz. per ton; lead, 14.8 per cent.; zinc, trace—is well mineralized. The remainder is sheared and slightly mineralized, though near the contact the mineralization is somewhat better.

The winze follows the dip at 35 degrees for 60 feet, then steepens to about 45 degrees to the sub-level driven from No. 3 raise. As it is not timbered this steeper part of the winze was not examined. It is reported to be largely unmineralized. There is nothing but a little shearing at the foot of the winze on the sub-level. The ground has been cut out for 4 feet to the south from the winze 50 feet below the adit. This exposes 2½ feet of limestone containing several streaks of galena, and would probably average about 15 per cent. lead. The north-west side of the winze shows little mineralization. Above this the south-east wall is quite well mineralized with galena, both disseminated and as small lenses. A drift goes 8 feet south-easterly from a point 15 feet below the level, the face exposing 3½ feet of disseminated mineralization of fair grade. Between this and the level, 6 inches along the foot-wall is heavily mineralized and there is 3 to 4 feet of disseminated mineralization above the foot-wall seam.

250 Level.—The adit goes in 440 feet to No. 3 raise through dark schist in which there are no noticeable bedding-planes. North-easterly-striking joints in the schist contain up to 6 inches of quartz. No. 3 raise goes up about 130 feet and from the top a drift runs south-easterly to connect with the bottom of the winze from the 80-foot level. The drift extends 135 feet from the raise, and at the end there are crosscuts 25 feet to the north-east and 30 feet to the south-west. From the latter, at a point 12 feet south of the main drift, a drift was being started southerly, following 6 inches to 1 foot of shear-gouge, just east of which fair lead mineralization was noted near the floor across 1½ feet. The rock exposed in the crosscuts is limestone, with the bedding-planes dipping 40 degrees to the south-west at the east end more steeply at the west end. The shear is probably the same one noted at the foot of the winze. The other workings from the 250-foot level were open as far as the foot of No. 1 raise, which was being reconditioned. The entrance to the south-west crosscut had been filled with debris from the raise, which is reported to encounter faulted ground from 70 to 100 feet above the level. The ground is timbered at the foot of the raise because of faulting. The fault higher up in the raise may be the one mentioned earlier, exposed in the crosscut, which runs east from the crosscut leading from the main adit to No. 1 raise. The writer was unable to go up No. 1 raise or along to No. 2 raise.

"B" Workings consist of an adit in about 25 feet, and caved workings, apparently trenching along the vein, extending 130 feet south-westerly from and rising about 25 feet above the adit in that distance. These are old workings in which nothing has been done in recent years. The hillside is covered with small trees and with overburden. The adit is driven south-easterly in flat-dipping grey schist. Limestone of unknown thickness is exposed 5 feet above the roof of the adit. The limestone strikes north-westerly and dips about 25 degrees to the south-west. The working is timbered to the face, where muck obscures all but the top 3 feet. There, in flat-lying schist, is very irregular flat-lying quartz 6 inches thick at the west wall, 1½ feet thick at the centre, and splitting toward the east into an upper limb 1 foot thick and a lower limb about 1½ feet thick. The latter goes below the muck surface. On the dump and along the last 50 feet of surface workings there is a good deal of quartz well mineralized with galena and pyrite.

Bluff Workings lie west of "B" workings. They consist of two adits, of which the lower is approximately 200 feet above the floor of the basin, at the top of a talus-slope. It is driven 10 feet through crumbly schist into granular limestone. The faulted contact strikes about north 55 degrees west and dips 40 degrees to the south-west. A drift extends along the fault, 30 feet to the north-west and 15 feet to the south-east. The limestone is impregnated with grains of galena and sphalerite. On the dump there are pieces of the granular limestone containing kidneys of well-crystallized galena. Some of the better disseminated mineralization

assayed: Gold, trace; silver, 1 oz. per ton; lead, 2.5 per cent.; zinc, 9.6 per cent.; while the selected sulphides assayed: Gold, trace; silver, 11.4 oz. per ton; lead, 20.8 per cent.; zinc, 13.3 per cent. The limestone extends above the working in a bluff. To the west is a talus-slope. About 200 feet south and 130 feet higher in elevation is the upper working. Here 15 feet of flat-lying limestone is overlain by schist. The contact is a fault striking north 60 degrees west and dipping 25 degrees to the south-west. An old adit was started under the fault, where there is some galena, apparently related to some quartz-filled stringers.

"C" Workings.—North-west of the Bluff, across the stream, are the "C" workings, consisting of three adits, of which the highest goes in 10 feet on a narrow quartz vein cutting black schist. The quartz contains some galena and sphalerite. About 25 feet lower is the second adit. At the portal is an irregular lens of quartz 10 feet wide containing kidneys of well-crystallized galena and pyrite. A sample of selected mixed sulphides assayed: Gold, 0.36 oz. per ton; silver 11 oz. per ton; lead, 23.3 per cent.; zinc, 0.2 per cent. The working goes in for 40 feet at south 50 degrees west. At 20 feet from the portal the quartz has pinched down to a width of 2½ feet and at 40 feet it has pinched out entirely. At this point the working branches, one branch following a joint for 55 feet at south 15 degrees west, the other branch going 25 feet at south 70 degrees west to a shear, which it follows for 80 feet at south 20 degrees west. The shear contains quartz-lenses sparingly mineralized with galena. The third adit is 80 feet lower and about 250 feet above the floor of the main basin. This adit goes in 190 feet at south 75 degrees west, encountering a shear at 90 feet. The face of the adit is in grit, which strikes north 50 degrees west and dips 60 degrees to the south-west. The shear, which is approximately under the portal of the middle level, strikes north 20 degrees east and dips steeply to the west. It contains from 1 to 1½ feet of slightly-mineralized quartz and 3 inches of gouge along the foot-wall. A few feet past the shear is a crosscut driven 27 feet to the north-west.

Galena Syndicate.

The *Ruth, Minnie, Charlotte, Vermont, Sheba, Cleopatra,* and *Ruth Fraction* Crown-granted claims and the *R.C.M. Fraction* are owned by the Galena Syndicate, of London, which is registered in Victoria. These claims are situated on Vermont Creek about 3 miles west of the confluence of that stream with Vowell Creek. The ground covered by the claims is largely south of the creek, which flows through the *Vermont* and *Cleopatra* claims. On Carbonate Mountain the syndicate also owns the *Diamond E.* and *Monitor* Crown-granted claims, which are not reported upon here.

Vermont Creek occupies a steep, deeply-cut valley and flows through a canyon in the last mile of its course. There is a bench at the top of the canyon which, on the north side, extends nearly to the claims. On both sides of the stream there are several slide courses. The ground rises very steeply south of the stream. The workings are principally on each side of a rock-slide which cuts through steep bluffs. To reach some of the workings narrow pathways have been made up the bluffs and ropes provided for safety. Some of the upper workings are on the steep lightly-timbered slope above the bluffs. The camp is on a bench at about 5,600 feet elevation (aneroid), below the steep slope, and about 1,000 feet north of the lower workings.

A sleigh-road from Spillimacheen to the property, some 38 miles in length, was completed in 1927 and has been used as a tractor-road, but has not been in use since 1930. This road follows the south side of the Spillimacheen to the point where it crosses Vowell Creek about 30 miles from the property. Near the crossing a pack-trail more or less following the route of the old sleigh-road from Parson joins the road. From the information at hand it appears that sections of the road as far as the crossing will now be impassable and the bridges unsafe. Much of this part of the road was an old sleigh-road, only slightly improved. The property can be reached conveniently with pack-horses from Carbonate Landing or Wells Landing, though from the junction of the Carbonate Landing Trail with the trail from Wells Landing, on the Spillimacheen, the route involves crossing the summits between the Spillimacheen, Bobbie Burns Creek, and Vowell Creek. The bridges across the Spillimacheen and Bobbie Burns Creek are in poor condition, though passable for pack-horses. The trail has not been kept up and is in poor condition. The distance from Parson via Wells Landing is about 6 miles less than the distance from Spillimacheen. From the junction near the Vowell Creek Crossing there is a fair road to 4-Mile, except for one section damaged by a snow-slide. From 4-Mile the grade is heavy until the bench above the canyon is reached. Thence to the mine the grade is easy. There is now no bridge across Vermont Creek at the property.

In the vicinity of the workings, which are principally on the *Ruth* claim, the rocks consist of bedded sediments, limestone, and argillites grading to quartzites, in which slaty cleavage is frequently strongly developed. In some cases the softer rocks have been rendered schistose rather than slaty. The bedding is frequently well defined and appears to strike generally from 30 to 60 degrees west of north and to dip either easterly or westerly at angles up to 25 degrees, both dip and strike being variable. The slaty cleavage, on the other hand, has a fairly constant strike and dips steeply to the north-east. Strong joints having about the same strike, but dipping steeply, usually to the south-west, cut the slates. Other fairly well-developed jointing is apparently of less importance. The slates vary from dark argillaceous to reddish quartzitic rocks in which beautifully developed slaty cleavage cuts the bedding-planes. Some of the slates are limy.

Quartz veins occur following the bedding and also strong jointing, which is vertical or dips steeply to the south-west and cuts the slaty cleavage. The latter type are frequently heavily mineralized with lead, zinc, and iron sulphides. Such heavily-mineralized veins in the joints vary from a ¼ to 18 inches in width. In one section such joint-veins are closely spaced over a considerable width. Moderate values in gold with silver, lead, and zinc are found in these veins. In similar veins or at some points in the veins the mineralization is almost entirely pyrite and arsenopyrite, carrying some gold and a little silver. White quartz veins following the bedding are irregularly and sparingly mineralized.

Limestone replaced by mixed sulphides appears to hold interesting possibilities. The mineralization may be quite heavy and carries good values in silver as well as in lead and zinc. Within the replacement-zone narrow quartz veins mineralized with sulphides also occur.

A feature of the mineralization in this area is the occurrence of arsenopyrite and of boulangerite along with galena, sphalerite, and pyrite. Boulangerite is a sulph-antimonide of lead. This mineral was identified in sections from a vein north of Vermont Creek, described below under "Ruth-Vermont Mines, Ltd." Sections from the Nelson ore-body, a replacement deposit, on the Galena Syndicate's property were also studied microscopically in the laboratory of the Department of Mines at Victoria, as were sections from veins on the property. The report of J. M. Cummings on the microscopic study of these sections is as follows:—

Nelson Ore-body.—"Three sections prepared of samples 5-155-4, 5-160-1A, and 5-160-1B. These appeared, from cursory examination, identical as to minerals present and relationships, there being no sufficiently outstanding difference to describe them separately on the basis of one section of each type.

"The mineralization consists of abundant subhedral to euhedral disseminated grains and aggregates of pyrite, and irregular masses of sphalerite and galena. The sulphide associations are in many places intimate; sphalerite enclosing, veining, and replacing pyrite; galena in intimate association with sphalerite, and most notably galena in the form of tiny blebs (down to 0.02 mm. in size, but usually greater than 0.05 mm.) replacing pyrite. Nearly every crystal of pyrite in the sections examined contained a few inclusions of galena, some up to 25 per cent. of their area."

Upper Pine Tree Vein.—"One section was prepared showing massive galena in contact with a fine-grained complex of pyrite and sphalerite the gangue being quartz with some carbonate."

Blacksmith Vein.—"One section was prepared consisting of massive to crystalline arsenopyrite in a quartzose gangue. Elongated crystals of arsenopyrite are present."

The *Ruth*, *Minnie*, and *Charlotte* claims are of long standing; it is reported that they were located in 1893. Some claims north of the creek had been located in 1889 and surveyed for Crown grant in 1894. The *Ruth*, *Minnie*, and *Charlotte* claims were surveyed for Crown grant in 1900. The other claims were located in 1925 and in 1929. Apparently most of the short adits on this property were started many years ago. Reference has been made above to early shipments prior to 1898. It appears that the property had lain idle for a long time when operations were started by the Galena Syndicate in 1926. Work was continued until 1929, since which time the property has been inactive.

On the *Minnie* claim there are some very old surface workings on the steep ridge south of the *Ruth* claim. They were not examined by the writer. On the *Charlotte* claim, lying east of the *Ruth*, are two short adits, one of which is driven for 8 feet on a quartz vein 2 to 6 inches wide, mineralized with pyrite and arsenopyrite.

The workings on the *Ruth* claim are the most extensive. They consist of three series of adits. Two of these series extend over a considerable vertical range, each series designed to prospect what was considered to be one vein. The eastern series, five in number, have been called the Blacksmith adits. The western series have been called the Pine Tree or Bluff workings and are three in number, of which the portal of the lowest is now buried under talus. The lowest working of the Blacksmith series consists of a 140-foot adit, from which a crosscut to the east failed to pick up the Blacksmith vein. A crosscut to the south-west picked up what may be the Pine Tree vein and another mineralized zone. The two series of workings are about 250 feet apart measured normal to the general strike of the fracturing. Between the lower workings of the two series is a steep rock-slide. The Bluff or middle Pine Tree adit is driven from the face of a cliff, west of the narrow rock-slide. Below this adit and between it and the Blacksmith adit mentioned is a series of workings on limestone replacement mineralization. These workings consist of the Lower and Upper Nelson adits and a stope open to the surface above the Upper Nelson. The lowest Blacksmith adit is reached easily from the camp by trail, but the fourth Blacksmith adit, the middle Pine Tree adit, and the Nelson workings can be reached only by climbing up or across the steep rock-slide and bluffs. The second and third adits of the Blacksmith series and the highest of the Pine Tree series are on the steep sloping hillside above the bluffs and are conveniently reached by a rather steep footpath.

Lacking a plan of the workings, an examination and description cannot be precise. An accurate survey would be difficult, and was impossible under the circumstances of the examination. Elevations given are based on barometric readings corrected so far as was possible. As the weather was rainy and varied greatly the elevations given may contain appreciable errors.

The highest working of the Blacksmith series is a short adit driven from a creek-bed at approximately 6,325 feet elevation. This was not visited by the writer as it could not be visited safely from the west side of the creek. The vein can be seen in the bluff on the east side of the creek above the adit. It appears to strike west of north and dips at about 70 degrees westerly. The second Blacksmith adit, at 6,250 feet elevation, goes in for 85 feet on a course of south 30 degrees east, apparently following a vein, which is a quartz-filled joint dipping vertically or steeply to the west, cutting soft slate, the cleavage of which dips 70 degrees easterly. The adit is closely timbered to 15 feet from the face. Above the portal and in the last 15 feet the vein can be seen; there it has a width of 6 to 9 inches, consisting of quartz mineralized with galena, pyrite, some arsenopyrite, and possibly some boulangerite. In the Annual Report of the Minister of Mines for 1930, B. T. O'Grady gives the following assay from a grab sample of sorted ore at the portal: Gold, 0.12 oz. per ton; silver, 23.1 oz. per ton; lead, 21.6 per cent.; zinc, 10.4 per cent.

At 6,160 feet elevation, and approximately 50 feet due west of the vertical projection of the vein in the higher adit, is an adit driven 40 feet on a course of south 50 degrees west. This is a drift on a vein 3 to 7 inches wide, dipping at 60 degrees to the south-west in harder slate having the same attitude as that in the second adit. The vein-fracture contains crushed slate, quartz, galena, and aggregates of arsenopyrite, massive, and as long crystals. A sample of this material assayed: Gold, 0.30 oz. per ton; silver, 2 oz. per ton; lead, trace; zinc, 0.7 per cent. This third adit of the Blacksmith series starts from the steep side-hill just at the edge of the bluff. The fourth of the series starts from the bluff, about 35 feet lower, and it is reached by climbing up the steep rock-slide and the bluff from below. An aerial tramway led from this working to a point near the camp.

At the portal the slaty cleavage has the same general attitude, but bedding-planes, plainly marked in the slate, have a low dip to the north-east; to the west also farther in the adit the bedding dips to the south-west. The adit goes in for 22 feet at south 35 degrees east under a vein, which is 2 feet thick at the surface and largely oxidized. It pinches to 4 inches; then widens to 1 foot, 20 feet from the portal, where cut by a cross-vein striking south 60 degrees east and dipping 70 degrees south-westerly; then narrows rapidly again. A few feet ahead the drift is filled with caved muck. The 1930 report by B. T. O'Grady states that the drift is 140 feet long and that the vein widens at 60 feet at a cross-vein where a stope had been opened from a 45-foot raise. The following is quoted from his report:—

"In the stope, which is about 20 feet long, the ore varied in width from 24 to 30 inches. In the back some oxidized decomposed material, containing a little galena, has been left, and

at the south-eastern end of this working the ore apparently peters out. Going south-easterly along the tunnel, beyond the raise, an unimportant stringer is followed to the face. Selected ore from the stope assayed: Gold, 0.07 oz. to the ton; silver, 65 oz. to the ton; lead, 27 per cent.; zinc, 13 per cent."

The highest working of the Pine Tree series is an adit at an elevation of 6,325 feet. It is driven 27 feet at south 50 degrees east from the end of a 10-foot cut, following a fracture which dips 85 degrees to the south-west, which cuts slate dipping 75 degrees north-easterly. The vein, consisting of quartz heavily mineralized with galena, some pyrite, and sphalerite, has been left on the west wall. Holes cut through the vein at intervals expose the width, which is from 8 to 11 inches along the drift. Breast-high, outside the portal, the vein is 1 foot wide and includes 2 inches of carbonates. A sample across the solid vein here assayed: Gold, 0.14 oz. per ton; silver, 29 oz. per ton; lead, 35.1 per cent.; zinc, 1.6 per cent. The width 6 feet above the portal is 6 inches.

The next working of this series is reached by climbing up the bluffs west of the rock-slide. It is at an elevation of 6,150 feet, slightly higher than the fourth adit of the Blacksmith series, and between 250 and 300 feet south-westerly from it. This adit follows a vein which for the first 20 feet strikes south 80 degrees west, then turns to south 50 degrees west. The vein is on the west wall of the working throughout its length of 75 feet; the dip is almost vertical. From the bend, for some distance in, a thin unmineralized quartz vein, dipping 20 degrees south-westerly, cuts the steep vein. Above the flat vein the other has a width of 1½ to 2 feet, while below its width is from 6 to 9 inches. It is well mineralized with galena and sphalerite. The roof has been stoped to a height of 12 feet in from the bend and the floor has been mined for a few feet. East of the portal for perhaps 60 feet along the face of the cliff the slaty cleavage strikes north 60 degrees west, dips about 65 degrees north-easterly, and is cut by a series of joints, dipping about 70 degrees to the south-west, spaced from 1 to 5 feet apart and filled with from ½ to 3 inches of sulphides and quartz. This appears to be about vertically over the southerly projection of the replacement mineralization in the Upper Nelson adit.

Mention has been made of an adit-crosscut which was designed to pick up the Blacksmith vein. This adit, at an elevation of 5,940 feet, starts from a steep bluff about 50 feet east of the rock-slide. It goes in at south 45 degrees east for 140 feet, from which point a crosscut runs 75 feet at north 70 degrees east, with two short drifts from it along the slate. The main working swings to the west from the same point, turning in 15 feet to a course of about south 35 degrees west, which it follows for about 220 feet. Seven feet from the end a drift runs for 30 feet at south 60 degrees east, following a vein dipping 75 degrees south-westerly. This is probably the continuation of the vein in the second adit of the Pine Tree series. The vein-width varies from 1 inch in the north wall of the adit to 1 foot at the widest in the first 20 feet of the drift, which section of the vein has been stoped for about 15 feet above the level. A sample across 8½ inches at the south-east end of the stope assayed: Gold, 0.10 oz. per ton; silver, 32 oz. per ton; lead, 18.8 per cent.; zinc, 14.4 per cent.

In the crosscut 40 feet north-east of this drift is another which goes for about 20 feet at south 60 degrees east. At the end a crosscut extends south-westerly for 12 feet. The short drift and crosscut with the main crosscut partly open up a zone having a width of 16 feet, of black, somewhat limy schist containing lenses of quartz and sulphides which strike south 60 degrees east and dip 60 degrees south-westerly. On the north-west wall of the main adit the eastern half of the zone contains three or four quartz-lenses from 3 to 18 inches thick, with parallel stringers which, with the schist, are varyingly mineralized with galena, pyrite, and sphalerite. The short drift and crosscut show similar mineralization. The western half is sparingly mineralized.

Nelson Workings.—About at 200 feet south 25 degrees west from the portal of the last-mentioned adit is the entrance to a small stope reached by crossing the slide. The stope is on a fracture in thin-bedded, limy slate. The fracture strikes at north 65 degrees west and dips 65 degrees southerly. It appears that galena to a thickness of several inches was removed, and some sphalerite was left on the hanging-wall. The stope is connected with the Upper Nelson adit about 20 feet below at an elevation of 6,020 feet. The adit runs for 50 feet at south 70 degrees east, then turns to a course of about south 40 degrees east for approximately 25 feet. At 30 feet from the portal is the bottom of the raise to the stope, while at 35 feet is the top of a raise from the Lower Nelson adit. This adit explores replacement mineraliza-

tion in bedded limestone which strikes north 30 degrees west and dips at 40 degrees north-easterly. The mineralized beds are overlain by limy slates. At the portal there is 12 to 13 feet of mineralized limestone above the floor. At the raise the upper contact is 7 feet, while at the face of the drift it is 6 feet above the floor. The mineralization is quite variable, consisting of pyrite, galena, and sphalerite, intimately mixed, and again in fairly pure segregations of the several minerals. The report of microscopic examination given above refers to specimens from both the Upper and Lower Nelson adits.

The Lower Nelson adit, at about 5,975 feet elevation, starts at the lower contact of limestone. The bluffs expose a thickness of 25 feet of limestone striking north 55 degrees west and dipping 45 degrees north-easterly. A white quartz vein, 1 to 2 feet thick, follows the bedding below 3 feet of limy slate immediately underlying the limestone. The adit follows the quartz vein south-easterly on a curving course for 110 feet. Comparatively little mineralization shows, except pyrite in the slate and some fine mixed sulphides in the roof. The raise is at about 40 feet from the portal. Under the raise a winze goes down on the dip to the north-east, with a 1-foot seam of mixed sulphides at the collar which assayed: Gold, 0.02 oz. per ton; silver, 14 oz. per ton; lead, 13.3 per cent.; zinc, 13.9 per cent. The mineralization in the lower part of the raise is weak. Twenty feet beyond the raise a crosscut runs north-easterly for 20 feet into the limestone. On the north wall 10 feet in there are 2 feet of fine-grained mixed sulphides. The white quartz vein contains a little galena and sphalerite. The following samples are of selected mineral from the upper level:—

Gold.	Silver.	Lead.	Zinc.	Description.
Oz. per Ton.	Oz. per Ton.	Per Cent.	Per Cent.	
0.02	4.0	3.6	7.0	Upper Nelson, 6 inches, chiefly pyrite.
Trace	56.4	46.6	13.5	Upper Nelson, selected galena.
Trace	23.6	17.2	36.0	Upper Nelson, selected sphalerite.

The mineralization is variable and bulk-sampling would be required to obtain a fair average. Much more work would have to be done to determine the extent of the deposit. It is apparent that a considerable volume of material contains sufficient lead and zinc to be regarded as good milling-ore. The silver content is high for replacement ore. The size of some particles, as indicated by microscopic study, is rather small, but it is probable that testing would indicate a good release of mineral grains within the limits of commercial grinding.

West of the Nelson workings is a wide rock-slide. To the east across the narrow slide, at the crosscut adit and the powder-house 50 feet to the west, there is some limestone which extends for 20 feet above the floor-level of the adit; it is somewhat warped and is slightly mineralized at the powder-house. The adit starts in limestone but runs out of it about 75 feet from the portal. Another outcrop of limestone is at the creek 250 feet east of the adit and at an elevation of about 6,075 feet.

Ruth-Vermont Mines, Ltd.

The Crown-granted claims, *Syenite Bluff*, *Agnes*, and *Black Horse*, and the following claims or fractions: *Agnes Fr.*, *Eureka*, *Mezeppa*, *Wildhorse*, *White Horse*, *Lion*, *Unicorn*, *Ruth No. 2*, *Charlotte Fr.*, and *Minnie Extension*, held by location, are in the name of G. W. Edwards. They are referred to as the property of Ruth-Vermont Mines, Limited, which is closely associated with the Witwatersrand Syndicate. These claims are situated on Vermont Creek, principally on the very steep north side, north-west of the holdings of the Galena Syndicate. The Crown-granted claims are of long standing. They are normally 6,000 by 1,500 feet. The *Agnes* and *Black Horse* were located in 1889 and surveyed for Crown grant in 1894. The locations were staked in 1930 and 1931 and some more recently. Some of these claims have been surveyed for Crown grant.

The workings on this property are all shallow and are quite limited. Lead-zinc mineralization has been exposed at several widely-separated points. At one of these, disseminated sulphide occurs in conglomerate and in the slate underlying the conglomerate. At another point lead-zinc mineralization occurs in bedded limestone.

The most conspicuous feature of the property is a narrow vein mineralized with galena, sphalerite, and boulangerite. The boulangerite, a sulph-antimonide of lead, forms a considerable part of the sulphide mineralization. Oxidation of this mineral yields the yellow oxide

of antimony. This marks the outcrop of the vein, which is traceable along a talus-slope and down a steep slide course for a horizontal distance of 1,800 feet from the crest of the divide between Vermont and Copper Creeks, at 8,300 feet elevation, to a point in the slide of 7,750 feet elevation. Cuts made in either the talus, or in the slide, fill in quickly. The vein is easily traced by the yellow-coated float and is usually easily found in place by a little digging. The actual vein, however, is rarely exposed. It appears to have a width of from 6 inches to 2 feet of mineralized quartz, which may include a considerable quantity of siliceous schist which the vein appears to follow. Sphalerite forms an important part of the vein-mineralization. The following analyses of two samples give an idea of the more valuable metallic contents:—

Gold.	Silver.	Lead.	Zinc.	Description.
Oz. per Ton.	Oz. per Ton.	Per Cent.	Per Cent.	
0.34	3.6	Trace	10.6	From vein near crest of ridge.
0.12	21.6	0.2	24.8	From vein well down in slide.

The report of a microscopic study of two specimens of this material made by J. M. Cummings at the Department of Mines' laboratory:—

"Ruth-Vermont; mixed sulphides. One section was prepared from massive sulphides consisting of arsenopyrite, sphalerite, and boulangerite. Arsenopyrite occurs as subhedral to euhedral grains and crystalline aggregates, surrounded by and in contact with relatively large, irregular masses of sphalerite. Boulangerite is disseminated throughout, replacing, in some places, both the other sulphides up to 25 per cent. of their area. This association is very intimate and it would be almost commercially impossible to make a clean separation, should this be desired.

"Ruth-Vermont; mixed sulphides. One section prepared from typical ore consists of massive boulangerite containing a few tiny rounded arsenopyrite crystals in a gangue of quartz and minor amounts of carbonate."

Though the nature of the outcrop is not favourable for permanent workings, it would be possible to reach the vein from a safe place on the ridge to the west by driving a curving crosscut, probably not more than 100 feet in length.

SPECIAL REPORTS.

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

Salmo-Malartic Mines, Limited.
Golden Fawn Mining Company, Limited.
Northwind Group, Paulson.
Silver Basin, Bugaboo Creek.

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.

A special report is also available on part of the Rossland Camp, where sufficient work has not yet been done by the Department to warrant a full report.

PROGRESS NOTES.

LODE-GOLD DEPOSITS.

BY

H. E. MIARD.

CRESTON AREA.

Creston Hill.—Situated west of Kitchener; operated by the Creston Hill Mining Syndicate; manager, Silas E. Jones. A crew of seven (four underground) was employed for some time, but operations had to be suspended in the fall owing to the failure of the water-supply.

Southern Kootenay Lake.

Bayonne Mine.—Operated by the Bayonne Consolidated Mines, Limited; N. H. Atkinson, manager. The mine is situated at the head of Summit Creek, at an altitude of approximately 6,200 feet, and is reached, from Tye Siding on the Canadian Pacific Railway, by a road permitting the use of motor-trucks and about 23 miles in length. Operations began in earnest last year as soon as the road had been reopened in the spring; the work done during the summer and early fall being mostly concerned with the erection of a cyanide-mill and the installation of a power plant, considerable progress having been made with the construction of comfortable living-quarters during the previous year. The construction-work was greatly facilitated by the use of a portable sawmill, the lumber used being almost entirely cut on the property.

The power plant consists of four Diesel engines, driving a 185-K.V.A. alternator, a 525-cubic-foot Canadian Ingersoll-Rand compressor, a 450-cubic-foot Holman compressor, and a 220-cubic-foot Gardner-Denver compressor, respectively. The last one mentioned may also be used to drive a 25-K.V.A. alternator instead of the compressor, if desired.

The underground working force, which consisted of only eleven men in September, had been increased to twenty-eight two months later, while the number of men employed on the surface decreased from sixty-four to forty-two in the course of the same period. The mill employs nine men.

The local topography is eminently favourable to development by means of adit-levels and to the natural ventilation of the mine-workings. The vein is narrow and the walls generally firm, circumstances rendering possible the introduction of both the shrinkage and the cut-and-fill methods of working. The development-work done during the year totalled 991 feet, including 321 feet of drifting, 624 feet of raising, and 46 feet of crosscutting. During the short time in which the concentrator was in operation 2,666 tons of ore was milled, this yielding 825 oz. gold and 2,113 oz. silver.

Spokane.—This property, situated on Wall Mountain and owned by Karl K. and Reuben M. Laib, who reside there permanently, is reached by a rather steep trail leaving the Bayonne Road at a point situated about 18 miles from Tye Siding. An arrastra, driven by an overshot water-wheel, was installed in a log building at the foot of the hill, on the bank of Canyon Creek, some years ago, but has not been used lately. In 1936 a total of 40 tons of ore was shipped.

Wisconsin.—Owned and operated by A. E. Frost, of Seattle; manager, E. W. McQuade. This property, situated on Hennessey Mountain at an elevation of 6,450 feet and about 13 miles by pack-trail from Midge Creek Siding on the Canadian Pacific Railway, has until now been operated only during the summer months. A wagon-road was constructed in the latter part of the year to a point some 5 miles distant from the railway and will greatly facilitate the handling of supplies when operations are resumed. Power is supplied by a 255-cubic-foot Gardner-Denver compressor driven by a McCormick-Deering portable Diesel engine, a Holman drill-sharpener, a small Holman hoist, and a Coppus Ventair fan completing the mechanical equipment.

The work done in the course of the past year consisted chiefly in the deepening of the winze and the driving of prospecting-drifts. Weak ground was encountered on the south side. The ore carries gold values in arsenical pyrite. A crew of eighteen men (nine of them underground) was employed during the summer. The development-work done included 10 feet of sinking, 537 feet of drifting, and 249 feet of crosscutting.

Lakeview.—Near Sanca, on the east side of Kootenay Lake. A small crew was employed for some time in exploratory and development work under the direction of C. J. Curtin.

Vicinity of Nelson.

Alpine Group.—At the head of Sitkum Creek. The Alpine Syndicate employed a small crew on the construction of a road to the property for some time, under the direction of B. N. Sharp.

Granite-Poorman.—Operated by the Livingstone Mining Company, Incorporated; manager, H. R. Smith. This property, situated on Eagle Creek, 5 miles west of Nelson, has been operated desultorily for a number of years, having been abandoned entirely to lessees until about three years ago. The total number of men employed varied between nine (with seven underground) and twenty-four (with fifteen underground). A 10-stamp mill is in operation, the gold and

silver values being recovered by amalgamation followed by concentration on Wilfley tables. Forty tons of dry ore was shipped to Trail and together with 34 tons of pyrite concentrates yielded 93 oz. gold and 145 oz. silver.

Venus-Juno.—This group, owned by R. Heddle, of Nelson, is situated above the *Athabasca*, on the summit of Morning Mountain, and is reached by a rather steep wagon-road. For some years the *Venus* has been operated spasmodically by lessees. The portals of all the adits but two have caved in and the workings are in rather poor condition. Three groups of lessees, headed by Geo. Gormley (Jr.), Bruno Sterna, and Geo. Gormley (Sr.), respectively, worked at the mine during the year. The shipments to the Trail smelter totalled 84 tons, yielding 112 oz. gold and 220 oz. silver.

Athabasca.—On Morning Mountain. Owned by the Noble Five Mines, Limited; manager, Paul Lincoln. The property was operated by lessees for some time during the year. Shipments to the Trail smelter totalled 38 tons of dry ore, this yielding 85 oz. gold, 300 oz. silver, 1,885 lb. lead, and 4,743 lb. zinc; and 1 ton of concentrates containing 2 oz. of gold, 9 oz. silver, 66 lb. lead, and 122 lb. of zinc.

Victoria and Jessie Group.—On Toad Mountain, about 8 miles by road from Nelson. An option was taken on this property by the Hammel interests and work began very early in the spring. A camp was built and a portable compressor was brought up. The operations, entirely of an exploratory nature, were limited to drifting on a mineralized dyke. A crew of eleven men was employed for some time, under the direction of Captain R. D. Adams, with W. J. Turner in charge of operations.

California.—Two groups of lessees, headed by Chas. M. Stevens and R. Basic, respectively, worked on the property for some time and shipped 45 tons of ore to the Trail smelter, this yielding 37 oz. gold and 138 oz. silver.

Perrier.—Owned by the Perrier Gold Mines, Limited; manager, Howard Thompson. A crew varying in number between six and eight was employed from May to November. Living accommodation for a few men was built, a compressor driven by a Diesel engine was installed, and development-work consisting of some drifting was done. Two tons of concentrates shipped to the Trail smelter from the property yielded 2 oz. gold, 6 oz. silver, 95 lb. lead, and 135 lb. zinc.

Catherine-Juno.—Situated on Evening Mountain, above the Perrier. Little work has been done up to the present time on this property, owned by William Jarvis. Most of the ore shipped in the past was obtained from open-cuts on the outcrop of the vein, which presents many points of similarity to that on the *Perrier*. In the course of the summer, operations were resumed on a more active basis, living accommodation was built, and the Catherine-Juno Syndicate was organized, with Wm. Conn as manager. The number of men employed varied between three and six. The development-work done amounted to 40 feet of drifting, and 24 tons of ore, yielding 6 oz. gold, 45 oz. silver, 496 lb. lead, and 133 lb. zinc, was shipped to the Trail smelter.

Euphrates.—Operated by the Euphrates Mining Company, Incorporated; manager, Sarkis Terzian. Active development proceeded on this property throughout the year, with the exception of seven weeks in the fall, when the operation of the hydraulic-power plant was so seriously hampered by ice forming in the flume that it became necessary to install a 125-horsepower Diesel engine to run the compressor. This, with the 16 by 9 by 16 cross-compound Canadian Rand compressor and an 8-k.v.a. d.c. generator, constitutes the present mechanical equipment. Arrangements are to be made (according to report) early in the current year to secure power from the West Kootenay Power and Light Company.

Good living accommodation was erected at the mine in October, the old camp at the foot of the hill near the railway being much too far from the mine. A crew varying in number between twenty and twenty-eight (an average of fifteen men underground) was employed. The work done was limited to development carried on from two adit-drifts following the *Ell Tee* and the *Minto* veins, respectively. From the former a crosscut was driven to the *Nickel Plate* vein, on which some drifting was done also. The work done during the year amounted to 1,250 feet of drifting and 750 feet of crosscutting.

Canadian Belle.—Some development-work was done on this property, owned by Michael Herman and situated about 3 miles from Hall Siding on the Great Northern Railway. Three men were employed from November 14th until the end of January of the present year and did 80 feet of drifting.

VICINITY OF YMIR.

Gold Cup.—At this property, situated near Porto Rico, the Gold Cup Mining Company, Limited, employed a crew of three men from the beginning of the year until December 1st, when operations were suspended for an indefinite period. The work done was entirely of an exploratory nature and consisted of 25 feet of drifting and 1,833 feet of diamond-drilling.

Tamarac.—Late in the year an option was taken on this property, belonging to E. W. Widdowson, of Nelson, by Balsam Tamarac Gold Mines, Limited. A small crew was employed on the construction of a tractor-road starting from the *Goodenough* mine. The next step will have to be the erection of living-quarters and the securing of an adequate water-supply for the camp, after which the present workings will claim their share of attention, a certain amount of repair-work being necessary.

Ymir.—Operated by the Ymir Consolidated Gold Mines, Limited; manager, B. H. Melvin. Operations during the year were practically restricted to the drawing and tramming of broken ore left in stopes.

Goodenough.—Situated on Elise Mountain and operated by the Ymir Consolidated Gold Mines, Limited; manager, B. H. Melvin. Very little work was done on this property during the winter of 1935–36, but milling was resumed after Major J. B. Cowell became consulting engineer for the company. Before active operations could begin, however, it was necessary to install a new power plant, the Diesel engine formerly in use having broken down hopelessly. A power-line was built and a Bury 16 and 10 by 10 compressor, driven by a 100-horse-power Canadian Westinghouse induction-motor operated at 2,200 volts, was installed. The very small crew employed originally gradually increased to fifty, the men working occasionally at the *Ymir* being included. The workings are in weak ground, requiring careful timbering and barring. A new adit-level was started in the autumn, but operations were suspended later, the intention being to delay further extension until the ground had been explored by diamond-drilling. Development-work totalled 2,458 feet, made up as follows: Drifts, 1,757 feet; raises, 522 feet; crosscuts, 179 feet. The diamond-drilling done amounted to 2,277 feet. A total of 11,816 tons was mined and milled, producing 1,159 tons of concentrates which yielded 3,016 oz. gold, 24,205 oz. silver, 414,167 lb. lead, and 257,312 lb. zinc (this including the production of the *Ymir*).

Blackcock.—A crew of fourteen (eight underground) was employed on this property for some time during the summer by the Blackcock Mining Company with Charles E. Chestnut as foreman. Power was supplied by a gasoline-driven portable compressor. The development-work done consisted of 433 feet of drifting and 30 feet of crosscuts. The output, treated at the mill of the Ymir Consolidated Gold Mines, Limited, amounted to 1,207 tons, from which 54 tons of concentrates were obtained, these yielding 216.4 oz. gold, 647 oz. silver, 19,448 lb. lead, and 10,161 lb. zinc.

Ymir-Wilcox.—This property, owned by the Ymir-Wilcox Mines, Limited, is operated under lease by the Wilcox Mining Syndicate, with James A. Cullinane as manager. This is essentially a summer operation, as snow-slides render the road impracticable in winter; a difficulty to which a shortage of water joined itself at the end of the season. Twelve men were employed, seven of them underground. A small stamp-mill is operated. The tonnage mined and milled amounted to 2,600, from which 134 tons of concentrates were obtained, these yielding 733 oz. gold, 1,294 oz. silver, 13,503 lb. lead, and 1,877 lb. zinc.

Yankee Girl.—Operated by the Ymir Yankee Girl Gold Mines, Limited; manager, Harry W. Seamon; mine superintendent, James D. Ferguson; mill superintendent, John Vallance. The number of men employed, salaried officials excluded, was 104 on an average—seventy-seven underground, eight on the surface, and nineteen at the mill. As the present workings are extending over a vertical height of some 1,200 feet, conditions eminently favourable to efficient ventilation by natural means are present. The entire output is hauled on the 1,235 level by a storage-battery locomotive. The winze has reached a depth of about 300 feet below the 1,235 level. Power for underground operations is supplied by a 20 and 12½ by 14 Canadian Ingersoll-Rand compressor, driven by a 250-horse-power synchronous motor operated at 2,200 volts, electric power being obtained from the West Kootenay Power and Light Company. The development-work done during the year consisted of 1,529 feet of drifting, 130 feet of crosscutting, 1,491 feet of raising, 161 feet of sinking, and 3,067 feet of diamond-drilling.

The tonnage mined was 43,149 and 43,378 tons were milled; this yielded 11,520 oz. gold, 46,107 oz. silver, 895,652 lb. lead, and 548,768 lb. zinc.

Ymir Centre Star.—This property, situated on Jubilee Mountain, overlooking Ymir, is operated by the Wesko Mines, Limited, with Harold Lakes as manager and Harry Stevens as mine superintendent. The mine is very advantageously situated, the only drawback being the possibility of snow-slides at a few points on the hillside, and the concentrator is also in a very convenient location. The conditions existing are eminently favourable to development by adit-levels and to natural ventilation. The flotation-mill was already in operation when the mine was visited for the last time, on November 24th, and the cyanide plant was being completed. Little was done underground during the summer, beyond the driving of a raise from the 560- to the 300-foot level, mill and aerial tramway construction being the chief activities throughout that period. Notwithstanding this, it was intended to handle a fairly large daily tonnage as soon as the mill could be brought into operation. The number of employees varied in different periods of the year with the nature of the operations on hand. At the time of the last inspection there were twenty-four men underground, seventeen on the surface, and eleven at the mill, with a readjustment contemplated for the time at which the construction-work would be completed and production could be established on the projected basis. Four hundred and fifteen tons of concentrates, yielding 910 oz. gold, 7,916 oz. silver, 184,670 lb. lead, and 51,881 lb. zinc, were produced.

Howard.—On the South Fork of Porcupine Creek, about 9 miles from Ymir. Owned by the Durango Gold Mines, Limited. An option was taken on the property in September by the Dentonia Mines, Limited, and Major A. W. Davis took charge of the operations. Early in the summer new living-quarters had to be erected, as the buildings previously in use had been carried away by a snow-slide in the course of the preceding winter. The work was largely of an exploratory nature, consisting principally in the driving of a raise and drifting on an ore-body found on No. 1 level. Nine men were employed (six underground). The development-work done consisted of 359 feet of raising, 388 feet of drifting, and 600 feet of diamond-drilling.

Harriet.—The owner, A. S. Curwen, of Ymir, shipped 5 tons of ore from this property; this yielding 10 oz. gold and 1 oz. silver.

Emerald.—A crew of four was employed in development-work on this property during the greater part of the year under the direction of Louis Johnson. Operations were suspended at the beginning of winter.

Queen.—On Wolf Creek. Operated by the Sheep Creek Gold Mines, Limited; manager, H. E. Doelle; mine superintendent, Frank Buckle; mill superintendent, Louis Vogel. The mine, brought into operation again three years ago after a long period of abandonment, is in difficult ground, apparently under considerable stress in the immediate vicinity of the vein and inclined towards very active spalling for some time after it has been exposed. Uncommonly heavy side-pressure has also been experienced at some points, this resulting in serious damage to the timbering. The entire production is hoisted through No. 2 shaft, sunk from the surface two years ago and now 894 feet in depth. A new Canadian Ingersoll-Rand hoist, with 48- by 38-inch drums, grooved for ⅞-inch rope, fitted with an automatic brake and driven by a 150-horse-power induction-motor (voltage 440), was installed at this opening towards the end of the year. The blind shaft, known as No. 1, sunk to a depth of 425 feet below No. 3 level west, is now used only for the handling of material.

The method of working followed is shrinkage-stoping with subsequent waste-filling where practicable. In the course of the year, crosscuts were driven to the *Hideaway* and *Yellowstone* veins from Nos. 5 and 7 levels, the former being met at two different elevations and proved by some drifting, while the latter had just been reached when it became necessary to interrupt the work temporarily while the shaft was being sunk to No. 12 level.

The development-work done during the year consisted of 3,464 feet of drifting, 623 feet of raising, 2,986 feet of crosscutting, 357 feet of sinking, and 564 feet of diamond-drilling.

The number of men employed varied slightly during the year. At the time of the last inspection there were sixty-eight working underground, thirty-two on the surface, and ten at the mill.

The total tonnage mined and milled was 54,967; this yielding 16,184 oz. gold and 5,004 oz. silver.

Kootenay Belle.—Operated by the Kootenay Belle Gold Mines, Limited; manager, Vere McDowall; mine foreman, John Tonkin; mill superintendent, Neil Munro. The property is situated on Sheep Creek, on a steep mountain-side offering excellent conditions for both development by crosscut adits and natural ventilation. The Hardinge-Hadsell mill and the flotation treatment have been discarded in favour of a cyanide plant which has been in successful operation since November 7th, treating about 65 tons daily. A considerable amount of development-work was done on No. 3 level during the year.

The old camp at No. 2 level has been abandoned and good living accommodation has been provided on the roadside near the mill. The number of men employed increased gradually from fifty-nine (thirty-six underground) at the beginning of the year to seventy-five (fifty underground) at the last inspection.

The development-work done during the year amounted to a total of 2,346 feet; this consisting of 1,953 feet of drifting, 105 feet of crosscutting, and 288 feet of raising. The tonnage milled was 15,508, from which 530 tons of concentrates were obtained; these yielding 6,977 oz. gold, 2,849 oz. silver, 21,898 lb. lead, and 36,718 lb. zinc.

Reno.—Operated by the Reno Gold Mines, Limited; manager, W. S. Ellis; mine foreman, A. K. Olsen; mill superintendent, Albert Norcross. Situated at the head of Fawn Creek, 15½ miles by road from Salmo, at an altitude of 6,200 feet. Exploratory and development work were carried on actively during the year, with a considerable enlargement of the tonnage immediately available as a result. A crosscut was started from No. 5 level towards the *Donnybrook* vein and the shaft was sunk to No. 11 level, this giving it a total depth of 750 feet. The power plant at the mine consists of a 19½ and 12 by 10 Canadian Ingersoll-Rand compressor driven by a 175-horse-power C.G.E. synchronous motor (voltage 550) and a Sullivan 22 and 18 by 14 compressor driven by a C.G.E. 300-horse-power synchronous motor (voltage 2,200). Electric power is obtained from the West Kootenay Power and Light Company, but, besides, the hydro-electric plant on Sheep Creek, 4½ miles from the mill and 7 miles from the mine, is still operated. This installation, fully equipped for semi-remote control, is able to develop 665 k.v.a. at 6,600 volts.

The vein is narrow and the walls strong, conditions favourable to the application of the shrinkage method of stoping in use. In winter violent snow-storms often prevent access to the mine otherwise than by means of the aerial tramway.

The average number of men on the pay-roll during the year (eight salaried officials excluded) was 132, the average number at work daily being 126 (seventy-seven underground, twenty-six on the surface, and twenty-three at the mill). The development-work done consisted of 2,124 feet of drifting, 933 feet of crosscutting, 273 feet of raising, and 6,445 feet of diamond-drilling.

The total tonnage mined and milled was 42,705, yielding 28,082 oz. gold, 16,435 oz. silver, 42,372 lb. lead, and 39,646 lb. zinc.

Bonanza.—On Wolf Creek. Owned by E. K. Donaldson and J. E. Read. Three men were employed on contract for fourteen days on this property and did 25 feet of drifting, this being assessment-work.

Gold Bank.—Situated about 1¼ miles from Park Siding on the Great Northern Railway. Work was carried on intermittently on this property during the first six months of the year by the Gold Bank Mining Syndicate under the direction of Wm. Conn. The average number of men employed was four. The development-work done consisted of 40 feet of drifting, 80 feet of crosscutting, and 30 feet of raising.

Erie Creek.

Mother Lode-Nugget.—Owned and operated by the Reno Gold Mines, Limited; manager, W. S. Ellis. Some exploratory work was carried on for somewhat more than half the year on this property, an average of nine men being employed (seven underground.) The work done consisted of 716 feet of drifting, 98 feet of crosscutting, and 494 feet of diamond-drilling.

Keystone.—Owned by the Dufferin Gold Mines, Limited. R. Sande, of Erie, and associates shipped 72 tons of ore from this property; this yielding 51 oz. gold, 150 oz. silver, 2,373 lb. lead, and 2,754 lb zinc.

Arlington.—Owned by the Relief-Arlington Mines, Limited; R. O. Oscarson, lessee; manager, Albert Johnson. A crew of seven was employed throughout the year, all drilling being done by hand. The vein is small, carries rather high values in gold at some points,

and is very moderately inclined. The walls vary in nature but are none too strong. The property has been operated by lessees for a number of years. The tonnage mined amounted to 546, yielding 622 oz. gold, 1,862 oz. silver, 36,534 lb. lead, and 24,928 lb. zinc.

Second Relief.—Owned and operated by the Relief-Arlington Mines, Limited; manager, S. M. Manning; mine superintendent, Walter Tattrie; mill superintendent, Gustav Kvist. The mine is situated 13 miles by road from Erie, and transportation presents a serious problem during the winter months, as the road is frequently blocked by snow-slides at several points. Entirely new living-quarters were erected during the year. The cyanide plant has been in operation for rather more than a year, with satisfactory results. Underground, production is becoming gradually concentrated in the lower levels below No. 5 and deepening of the shaft will henceforth become an annual undertaking. This can be done successfully only during three of the winter months, the inflow of water being then reduced to its minimum. During the year the number of men employed varied between seventy-three and ninety-nine (from thirty-five to fifty-three underground).

The development-work done consisted of 1,740 feet of drifting, 375 feet of crosscutting, 127 feet of sinking, 315 feet of raising, and 1,132 feet of diamond-drilling. Exploratory work done during the summer on a vein discovered on the north side of the gulch gave encouraging results. The tonnage mined was 34,776, of which 25,462 tons were milled; this yielding 10,097 oz. gold and 3,177 oz silver.

Rossland Area.

Velvet.—On Sophie Mountain, about 12 miles west of Rossland. Operated by the Velvet Gold Mining Company, Incorporated; manager, Andrew J. Arland. The mine was operated irregularly during the greater part of the year and underground work was undertaken on a systematic scale only in the month of November. An improvement of capital importance was the abandonment of the old wood-burning boilers, for which electric power obtained from the West Kootenay Power and Light Company was substituted. The mill building is a remodelled old structure. A new bunk-house was erected during the summer. The average number of men employed was forty-two, with a maximum of sixteen underground.

I.X.L.—On Mount Roberts, west of Rossland. Operated by the I.X.L. Lessors, Limited (c/o B. G. Lees, Rossland); manager, Ole Osing. The number of men employed varied between eight and nine (four to six underground). The output amounted to 361 tons, yielding 804 oz. gold and 297 oz silver.

O.K.—On Mount Roberts. Operated by the O.K. Leasing Company (c/o A. Williams, Rossland); manager, John Hendrickson. Three men were employed. The development-work done consisted of 150 feet of drifting and 27 feet of raising. The tonnage mined was 64; this yielding 17 oz. gold and 56 oz. silver.

Midnight.—On Mount Roberts. Operated by the Midnight Syndicate (Rossland). Two men worked on the property and shipped 70 tons of ore, yielding 22 oz. gold and 54 oz. silver.

Gold Drip.—On Mount Roberts. James Benson, of Rossland, lessee. Two men worked on the property during the year. The workings are in rather weak ground and careful timbering and filling are necessary. The tonnage mined amounted to 41; this yielding 27 oz. gold and 62 oz. silver.

Jumbo.—On the East Fork of Sheep Creek, about 2¼ miles west of Rossland. M. Slubowski and associates shipped 81 tons of ore from this property; this yielding 24 oz. gold and 20 oz. silver.

Silverine.—On Monte Cristo. The owners, A. O. Fried and M. Penny, of Rossland, shipped 33 tons of ore from this property; this yielding 17 oz. gold and 26 oz. silver.

Cliff.—On Red Mountain. Owned by L. A. Campbell, of Trail. H. Hanson and F. Birch held a lease on the property for some time and shipped 29 tons of ore, which yielded 16 oz. gold and 65 oz. silver.

Evening Star.—On Monte Cristo. This property was operated desultorily during the year by several groups of lessees, the production coming chiefly from surface cuts and shallow workings. A total of 287 tons of ore was shipped to the Trail smelter; this yielding 182 oz. gold and 156 oz. silver.

Iron Colt.—J. and A. Perry and C. Adams, of Rossland, shipped 13 tons of ore from this property; this yielding 4 oz. gold and 13 oz. silver.

Georgia Group.—Late in the year the Gold Cup Mining Company, Limited (manager, R. W. Haggen, Rossland), began operations on this property. Four men were employed and the development-work done amounted to 35 feet of sinking.

Surface and underground operations were conducted by lessees at the *Iron Mask, Centre Star, War Eagle, Josie No. 1, Josie No. 2, Le Roi, Black Bear, Annie,* and *Columbia-Kootenay,* all situated on Red Mountain except the last mentioned. Ninety-five men were employed on thirty-five separate leases, and the total tonnage shipped to the Trail smelter amounted to 9,335; this yielding 8,528 oz. gold and 9,344 oz. silver.

Beside those already enumerated, operations were conducted by lessees, on a small scale and for a comparatively short period of time in each case, on the following properties: *Monday, May Flower, Blue Bird, Mighty Midas* (from which M. M. Butorac shipped 3 tons), *Hattie* (from which 5 tons were shipped), *Ural* (from which C. J. Butorac shipped 4 tons, yielding 5 oz. gold and 9 oz. silver (all situated in the vicinity of Rossland), and *Norway,* south of Trail.

Silverton-New Denver Area.

L.H.—Situated on Red Mountain, at the head of Fingland Creek, the camp being at an altitude of 5,250 feet. Eleven men were employed on the property for some time in the course of the summer by the Pacific Mines Petroleum and Development Company, Limited, under the direction of H. E. Rose.

Lardeau Area.

Meridian.—On Lexington Mountain, near Camborne. Owned and operated by the Meridian Mining Company, Limited, with W. R. Blochberger in charge of operations. The mine was abandoned at the end of the summer. The milling machinery has since been sold for reinstallation in another district. The total number of men employed varied between fifty-eight (thirty-one underground) and forty-six (with twenty-eight underground). The development-work done consisted of 1,622 feet of drifting, 880 feet of raising, and 93 feet of sinking. The tonnage mined and milled was 27,273, yielding 2,749 oz. gold and 1,416 oz. silver.

Multiplex.—Situated on the south side of Poole Creek, about 1¼ miles from Camborne. Late in the year, operations were started on this property by W. S. Harris, of Nelson. A crew of six was employed.

Silver Cup.—Situated about 8 miles from Ferguson and owned by the Ferguson Mines, Limited. E. R. K. Waite and E. Kingston employed a crew of twenty-three (subsequently reduced to fifteen) on construction-work from November 1st until the end of the year. New living-quarters were provided, these taking the form of a 74-by-22-foot frame building. In the early years of this century a 20-stamp mill was operated on the property, the values being recovered by concentration on Dodd buddles, chloridizing, and amalgamation. Apparently this method was not entirely successful.

SILVER-GOLD DEPOSITS.

Slocan Area.

Chapleau.—Situated on the south side of the divide between Lemon and Springer Creeks. A. G. Ewing and associates, lessees, shipped 22 tons of ore, with metal contents of 28 oz. gold and 889 oz. silver, from this property.

Gold Viking.—Situated on the north side of Springer Creek. A shipment of 3 tons of ore was made by G. Henderson from this property. The metal contents were 5 oz. gold and 41 oz. silver.

Meteor.—Wm. Hicks and two associates, lessees, worked on this property for about four months during the summer. The development-work done amounted to 30 feet of drifting and 20 feet of raising. A shipment of 2 tons yielded 2 oz. gold and 388 oz. silver.

McAllister.—This property, situated on the western slope of London Ridge, was operated under lease by the New Denver Mining Syndicate, with George Allen as manager, from the month of June until the end of the year, a total of eleven men being employed. Difficulty experienced in keeping the road open from Three Forks to the lower tramway terminal led to the reduction of this number to three after the first heavy fall of snow. Present operations are limited to the recovery of moderately-rich ore, left in parts of the mine in which the walls were too weak to permit extraction by the shrinkage method of stoping formerly in use. The

work has to be carried on slowly and carefully, with hand-steel, a very small consumption of explosives, regular timbering, and close filling. There is no mine-timber fit to be considered as such on the property. The tonnage mined and shipped amounted to 1,078; this yielding 12 oz. gold and 58,251 oz. silver.

Little Daisy.—This property, situated on 8-Mile Creek and owned by Mrs. McNaught, of Silverton, was operated under lease by A. G. and A. E. Erickson for a little over eight months. The development-work done during this period consisted of 20 feet of drifting, 56 feet of raising, and 38 feet of sinking. The 23 tons of ore shipped yielded 41 oz. gold and 48 oz. silver. Late in the year the Slocan Lake Gold Mining Company, Incorporated (headquarters, 503 West Sprague Avenue, Spokane, Washington), took an option on the property, but little was done beyond an examination by a consulting engineer.

DRY SILVER-ORE DEPOSITS.

Slocan Area.

Ottawa.—Operated by the Ottawa Silver Mining and Milling Syndicate; manager, W. R. Green, Nelson. The mine is situated on Springer Creek, about 6 miles by road from Slocan City. It was worked rather extensively at one time, but was abandoned by the Consolidated Mining and Smelting Company of Canada in 1917. Afterwards various groups of lessees worked on the dumps, from which several shipments were made. A mill, built in 1921 by L. H. Biggar, to treat the low-grade ore on these dumps was completely destroyed by fire in the following year, and the property had been totally abandoned for a considerable time when the present operating company acquired it in 1935.

The workings are in ground none too strong at many points and requiring careful timbering. The management had no plans of the old workings on hand at the time of the last inspection, and the exact location of No. 6 level, driven from a winze and now flooded, was not known with any degree of certainty. A crew of six was employed during the year; the reopening of two levels was completed and a new adit was started. Some small stringers of high-grade ore, discovered accidentally in the hanging-wall, were mined out by hand. A vertical 9⅜-inch and 5½- by 5½-inch air-compressor, supplied by the Chicago Pneumatic Company and driven by a portable Hercules Motor Corporation 4¼- by 5¼-inch gasoline-engine, was installed. A flotation-mill was built about a mile away from Slocan City, but it had not been brought into operation at the end of the year.

Morning Star.—Henry E. Scovil had a small crew engaged in exploratory work on this property, situated on Springer Creek, from the month of July until the beginning of winter.

Nettie L.—The Security and Investment Corporation, Limited (I. Rosenthal, president, 814 Hall Building, Vancouver), employed five men for some time during the summer, mostly in trail improvements and repair-work to buildings.

SILVER-LEAD-ZINC-DEPOSITS.

Cranbrook Area.

*Sullivan.**—Owned and operated by the Consolidated Mining and Smelting Company of Canada, Limited; general superintendent, A. B. Ritchie; mine superintendent, W. Lindsay; mill superintendent, H. R. Banks.

The waste-filling programme was resumed in the beginning of August and finished for the season on November 15th. During this period 115,000 cubic yards of gravel was placed in the mine by means of a 70-degree shaft 800 feet in length; operations on the surface were carried on with two "Caterpillar Diesel" tractors, one of which operated with a "Carco" bulldozer and the other with a "Le Tourneau Carryall." The thickness of the gravel at the shaft-collar was approximately 40 feet, and the above machines transported the gravel to the shaft from within a radius of 400 feet. About 10 per cent. of water was added to the gravel at the top of the shaft, and this eliminated the dust as well as distributing the material to all corners of the stope. An extensive programme of development and general improvement has been carried out during the year at the 3,901-shaft district. This included the building of ore and waste pockets at the 3,350 level, as this will be the main loading and hoisting station for all ore extracted between this elevation and the 3,900 level. The hoist-room at the top

* By John MacDonald.

of the shaft has been enlarged to accommodate a 500 horse-power Vulcan hoist which was shipped from Anyox and thoroughly overhauled in the shops at the mine under the supervision of R. Gosse, master mechanic.

The 3,927 raise has been thoroughly repaired and equipped as a man and material shaft to facilitate operations in the south districts of the fourth level. The hoist installed at this shaft is a Fullerton, Hodgart & Barclay, with single drum keyed on the shaft and working on second motion.

Developments during the year consisted of 3,085 feet of drifting, 1,474 feet of crosscutting, 4,415 feet of raising, 319 feet of sinking, and 9,007 feet of diamond-drilling; 1,910,619 tons were mined and 1,901,476 milled, and this yielded 6,912,864 oz. silver, 184,316 tons lead, and 118,570 tons zinc.

Windermere Area.*

Excelda Mine.—Owned and operated by Thunderbird Mines, Limited; R. C. Moffitt, president and general manager. Owing to the condition of the roads and trails leading to the mine, operations were later than usual in resuming for the season, and these were further curtailed due to the exceptionally dry season reducing the supply of water available for mine use. A crew of twelve men was employed and some 260 feet of drifting done underground; a new wash and change room was also built at the camp.

Vicinity of Field.*

Monarch and Kicking Horse Mines.—Owned and operated by Base Metals Mining Corporation, Limited; Thomas Oxley, mine superintendent. All operations during the year have been principally confined to a programme of diamond-drilling, prospecting and development work in both mines, the mill remaining closed since December, 1935.

Slocan-Ainsworth Camp.

Ainsworth Area.

Number One.—Owned by the Consolidated Mining and Smelting Company of Canada, Limited. A group of lessees headed by R. G. Dickinson worked for some time on the property.

Banker.—Operated by the Banker Mines, Limited, and later by the Ainsworth Mines, Limited, with L. McLellan as manager. A small hoist and a compressor, electrically driven, were installed in October. A crew of five or six was employed during the greater part of the year. The tonnage mined and shipped was 503; this yielding 12,750 oz. silver and 552,105 lb. lead.

Krao.—This property was operated during the second half of the year by a group of lessees headed by H. Lind, of Kaslo. A shipment of 17 tons yielded 663 oz. silver and 15,570 lb. lead.

Horse Shoe.—H. Lind, of Kaslo, shipped 2 tons, yielding 100 oz. silver and 1,665 lb. lead, from this property.

Highland Surprise.—Also known as the *Phoenix* group. Situated near Retallack, between the gulches of Lyle and Whitewater Creeks, and operated by the Old Colony Trading Company. Operations were started in the latter part of the year; a trail was built and a log cabin, 18 by 40 feet, was erected as living-quarters for the small crew, which it is intended to keep at work all winter.

Vicinity of Slocan City.

Lakeview.—Situated on Springer Creek, about 1¼ miles from Slocan City. E. H. Kinder, P. Johnson, and H. Kinder began operations on this property early in the summer. Operations were limited to development and necessary construction-work. A crew of seven was employed.

Slocan-Silverton Area.

Mammoth.—Situated on Avison Creek, about 4 miles by road from Silverton, and operated by the Western Exploration Company, Limited, with A. M. Ham as manager. This property, the most important in the Slocan District during the previous year, was closed down in March owing to the danger presented by impending snow-slides, those having already taken place having rendered the road to the mine practically impassable at the time. The mine remained idle during the balance of the year, but an early resumption of operations is contemplated.

* John MacDonald.

The workings are in difficult ground. Weak walls, with a large body of irregular structure and containing occasionally a considerable percentage of waste, are factors combining to render the utmost skill and care necessary in the planning and conduct of mining operations.

A crew of about ninety (fifty underground) was employed in normal circumstances. When the mine was closed down this number had been temporarily reduced to sixty-four. The development-work done totalled 300 feet; this comprising 50 feet of drifting and 250 feet of raising. The tonnage mined was 9,080 and 9,485 tons were milled, yielding 95,087 oz. silver, 615,600 lb. lead, and 776,561 lb. zinc.

Standard.—Owned by the Western Exploration Company, Limited. Lessees working on this property during the greater part of the year shipped 48 tons of ore, yielding 1 oz. gold, 1,651 oz. silver, 14,606 lb. lead, and 17,493 lb. zinc.

Bosun.—Situated on Slocan Lake, between New Denver and Silverton. Owned by C. J. Campbell and operated by Jos. Beber and Jos. Zamboni, holding separate leases, with a total of five men. On November 8th a crew of five, sent to the property by the newly-organized Bosun Mining Company (with headquarters at Vancouver), began the work of unwatering the winze, which continued until the end of December, when the compressed-air pipe-line was taken up and the place was abandoned again. During the year the lessees shipped 177 tons of ore with metal contents of 3 oz. gold, 12,740 oz. silver, 57,197 lb lead, and 92,690 lb. zinc.

Hewitt.—Owned by the Galena Farm Consolidated Mines, Limited, and situated 6 miles by road from Silverton. Three groups of lessees, with a total of ten men and headed by Ed. Mathews, R. E. Burke, and E. Erickson, respectively, worked on the property during the second half of the year, undertaking a considerable amount of repair-work in order to reach the point at which they intended to start operations. The mine had been abandoned since the beginning of 1930 and many parts of it are in very poor condition, the timber having suffered from the inroads of dry-rot to an extraordinary extent. The development-work done was limited to 16 feet of sinking. Sixty-seven tons of ore mined and shipped yielded 7,670 oz. silver and 18,193 lb. lead.

Galena Farm.—Situated on Hasty Creek, south of Silverton, and operated by a group of eight lessees, headed by Warren Nelson, who started work at the mine at the beginning of July. Here, also, a large amount of repair-work had to be undertaken before active mining operations could begin. It has been found inadvisable, up to the present time, to attempt to operate the mill, owing to the poor condition of the flume. The tonnage mined and shipped was 202; this yielding 13,778 oz. silver and 121,368 lb. lead.

Cliff.—J. H. Dalzell, of Silverton, shipped 5 tons of ore from this property, the metal contents being 273 oz. silver, 1,314 lb. lead, and 1,794 lb. zinc.

Molly Hughes.—Situated on Slocan Lake, north of New Denver. The Molly Hughes Mining Company kept a crew of three at work on this property during the greater part of the year under the direction of O. C. Born. Four tons of ore shipped to the Trail smelter yielded 1 oz. gold, 455 oz. silver, 239 lb. lead, and 214 lb. zinc.

Mountain Chief.—This property, situated about 2 miles from New Denver and owned by H. Giegerich, of Kaslo, was operated throughout the year by John Cechelero and associates. The tonnage mined amounted to 40, but this was not shipped.

Jo-Jo.—Situated on Kane Creek. The trail from the lower terminal of the aerial tramway at the *McAllister* to this property was rebuilt, widened, and relocated in part, a bulldozer being brought in for this purpose, the living-quarters were repaired, and some development-work was done, in the course of the late summer, by the owner, John Teir, of New Denver.

Slocan Monitor.—Owned by the Slocan Monitor Silver Mines, Limited, and situated at Three Forks. C. I. Vandergrift and associates began work on the property in December, the total working force consisting of three men. The development-work done consisted of 30 feet of drifting. Seven tons of ore shipped yielded 1 oz. gold, 363 oz. silver, and 6,474 lb. lead.

Three Forks-Sandon Area.

Victor.—Near Three Forks, owned by Mrs. Dacy Petty, of Nelson, and operated on lease by Ernest Doney & Son. During the year, 310 feet of drifting and 25 feet of raising were done. Twenty-nine tons of ore shipped yielded 2 oz. gold, 4,809 oz. silver, 34,988 lb. lead, and 4,111 lb. zinc.

Queen Bess.—Owned by the Queen Bess Consolidated Mines, Limited. Lessees working on this property shipped 29 tons of ore with total metal contents of 1 oz. gold, 2,154 oz. silver, and 33,943 lb. lead.

Black Colt.—Owned by the Queen Bess Consolidated Mines, Limited; manager, Clarence Cunningham. E. J. Vandergrift and associates operated the property on lease until December. The development-work done consisted of 200 feet of drifting, 250 feet of crosscutting, and 100 feet of raising. The ground is soft and no explosives were used. The tonnage mined and shipped amounted to 125; this yielding 2 oz. gold, 5,622 oz. silver, 5,783 lb. lead, and 52,476 lb. zinc.

Palmita.—Owned and operated by the Queen Bess Consolidated Mines, Limited, with Clarence Cunningham as manager. A crew of nine was employed. The ground is soft and explosives are used very sparingly. The tonnage mined and shipped was 243; with total metal contents of 16,255 oz. silver and 250,298 lb. lead.

Sunrise.—On Silver Ridge. Owned and operated by the Silver Ridge Mining Company, with R. A. Grimes as manager. A great deal of work had to be done before the underground operations could be started; this including road improvements and new road-construction, the erection of comfortable living-quarters for a small crew, building a stable and a blacksmith shop, and securing an adequate water-supply for the camp, the latter being a rather difficult undertaking owing to the nature of the mountain-side at that point. A crew of eleven was employed.

Other properties operated in the Sandon District during the year were: *Elkhorn*, from which A. Forsyth and partner shipped 5 tons, yielding 189 oz. silver, 4,934 lb. lead, and 502 lb. zinc; *Hinckley; Cinderella*, from which shipments totalling 13 tons were made by two separate lessees, the total metal contents being 822 oz. silver and 14,614 lb. lead; *Silversmith*, from which C. Stewart and three associates shipped 28 tons, yielding 1 oz. gold, 2,691 oz. silver, 32,689 lb. lead, and 2,326 lb. zinc; *Wonderful*, from which W. D. Pengelly shipped 4 tons with metal contents of 279 oz. silver, 4,553 lb. lead, and 518 lb. zinc; *Sovereign*, operated by W. G. Balbernie and partner, who shipped 4 tons of ore, yielding 163 oz. silver, 2,879 lb. lead, and 649 lb. zinc; *Noble Five*, from which 9 tons of ore, yielding 836 oz. silver, 10,348 lb. lead, and 1,530 lb. zinc, were shipped; and *Number One*, from which the owner, J. M. Harris, shipped 87 tons with total metal contents of 2 oz. gold, 6,552 oz. silver, 97,803 lb. lead, and 9,936 lb. zinc.

In addition, J. H. Pendry and partner shipped 2 tons of ore from the *Rio*; this yielding 907 oz. silver, 799 lb. lead, and 256 lb. zinc.

Vicinity of Albert Canyon, Revelstoke Mining Division.

Allco Silver.—Situated at the head of Woolsey Creek, about 14 miles from the station at Albert Canyon, on the Canadian Pacific Railway, and operated by the Allco Silver Mines, Limited. Transportation is by pack-horse for the first four or five miles from the mine, and then by motor-truck to Silver Creek Siding. The nature of the deposit has been thoroughly described in the Annual Report for 1935. All mining is done by hand. A crew of eight was employed, with M. C. Arnold and subsequently Roy D. Watson as manager. The development-work done consisted of 270 feet of drifting and 57 feet of crosscutting. Ninety-nine tons shipped gave 6 oz. gold, 6,742 oz. silver, and 86,519 lb. lead.

Carnes Creek, Revelstoke Mining Division.

Mastodon Group.—A small crew was employed for some time in exploratory work on this property by the Fawn Mining Company, Limited.

PLACER DEPOSITS.

Lardeau Area.

De Mers Placers.—The De Mers Mining and Milling Company, Limited (manager, Milton A. De Mers), employed three men for some time on placer claims in the neighbourhood of Ferguson. It is understood that the same company is also interested in the *True Fissure*.

NON-METALLICS.

Southern Kootenay Lake.

Kootenay Lake Lime Quarry.—Situated on Kootenay Lake, about 1¼ miles east of Procter, and operated by the Consolidated Mining and Smelting Company of Canada, Limited. A crew of seven men was employed throughout the year in development-work, which comprised 470 feet of drifting, 248 feet of crosscutting, and 63 feet of raising. The tonnage shipped was 2,300.

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ILLUSTRATIONS.

VICTORIA, B.C.:
Printed by CHARLES F. BANFIELD, Printer to the King's Most Excellent Majesty.
1937.

4,725-237-4740

The Annual Report of the Minister of Mines is now issued in parts as follows:—

Part A.—The Mining Industry (Statistical Review). John F. Walker.

Part B.—North-western Mineral Survey District (No. 1). Joseph T. Mandy.

Part C.—North-eastern Mineral Survey District (No. 2). Douglas Lay.

Part D.—Southern and Central Mineral Survey Districts (Nos. 3 and 4). M. S. Hedley.

Part E.—Eastern Mineral Survey District (No. 5). H. Sargent.

Part F.—Western Mineral Survey District (No. 6). B. T. O'Grady.

Part G.—Inspection of Mines. James Dickson.

PART F

ANNUAL REPORT

OF THE

MINISTER OF MINES

OF THE PROVINCE OF

BRITISH COLUMBIA

FOR THE

YEAR ENDED 31ST DECEMBER

1936

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:
Printed by CHARLES F. BANFIELD, Printer to the King's Most Excellent Majesty.
1937.

BRITISH COLUMBIA DEPARTMENT OF MINES.

VICTORIA, B.C.

Hon. GEORGE S. PEARSON, *Minister.*

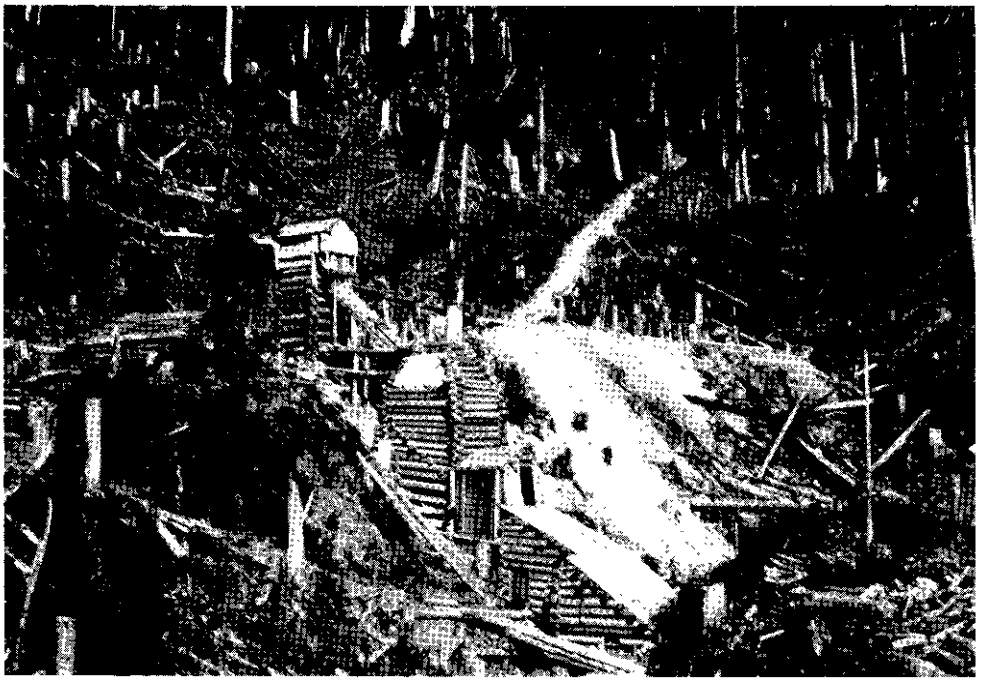
JOHN F. WALKER, *Deputy Minister and Provincial Mineralogist.*

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.*



Home Gold Mining Co., Ltd. Mill, Coquihalla Area.

Herbert Arm, Vancouver Island.

Emory Creek Placer Training Camp, Fraser River.

Mount Arrowsmith from Havilah Gold Mines, Ltd.

PART F.

WESTERN MINERAL SURVEY DISTRICT (No. 6).

BY

B. T. O'GRADY.

GENERAL SUMMARY.

During 1936 one of the most important features in this district was the return to capacity production by Britannia Mining and Smelting Company at their Howe Sound property. Other operations, such as Pioneer and Bralorne, maintained production, and generally there was no important change in the scope of mining activity in the Western Mineral Survey District.

Prospecting and investigation of dormant properties has latterly been stimulated by the increase in the prices of base metals, notably copper, and new undertakings are expected to result. Prospecting and development generally has been carried on actively throughout the district.

Production was initiated at the property of the Ashloo Gold Mines, Limited, near Squamish during the latter part of the year.

LODE-GOLD DEPOSITS.

MINTO CITY VICINITY.

Bridge River Camp.

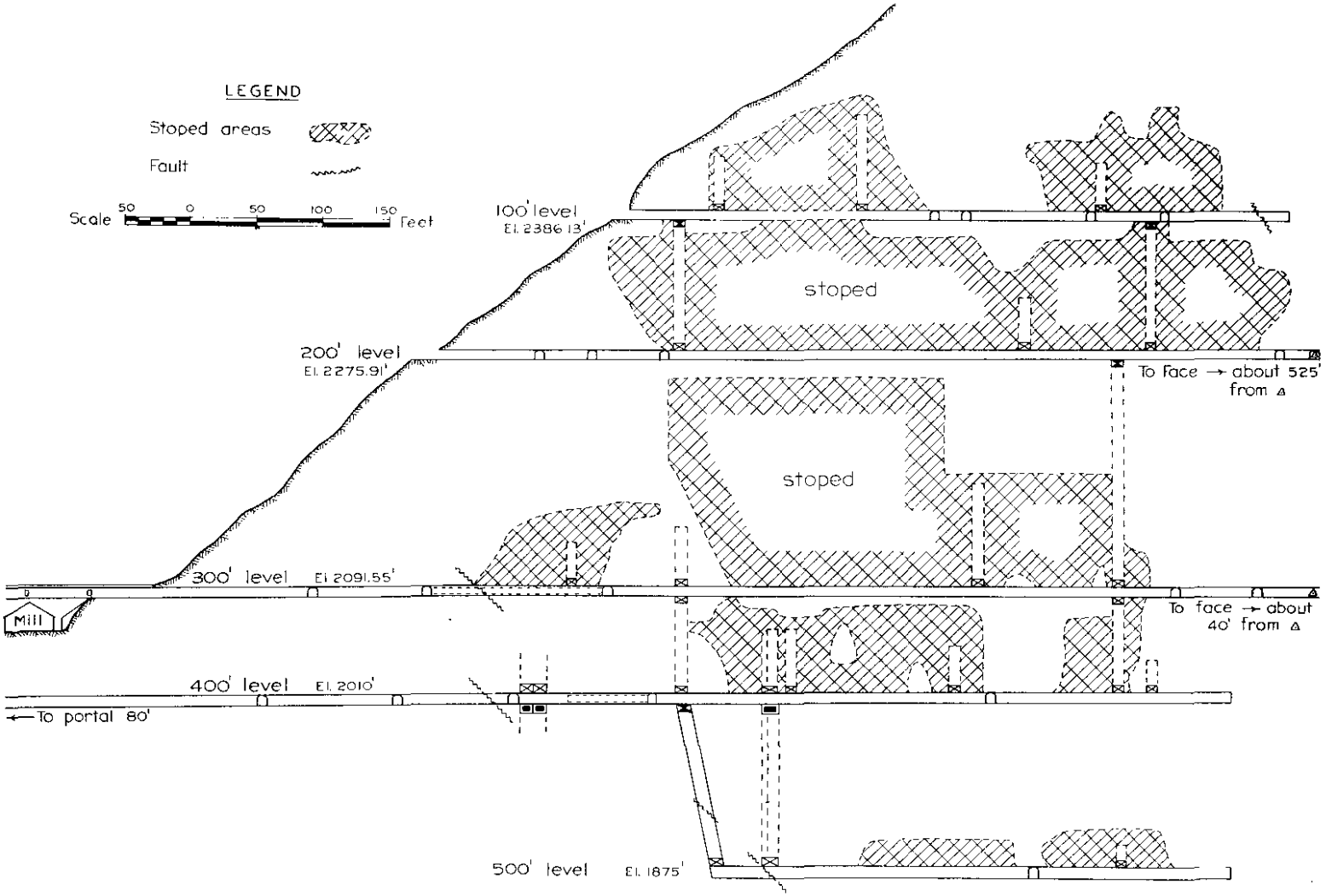
Minto Gold Mines, Ltd.

The property of this company, in the Lillooet Mining Division, includes the *Alpha* and *Omega* groups, consisting of fifteen surveyed mineral claims and fractions held by location. These holdings, which extend northerly and southerly across Bridge River, are shown on B.C. Department of Lands Mineral Reference Map No. 21T269. The principal workings, on the *Omega No. 1* claim, are situated on the open, steep, sparsely-wooded ground sloping southerly to the river. Elevations in this area vary from 2,010 at the *River* adit to 2,531 feet at the highest open-cut. The mine and mill adjoin the highway to the north at a point about 34 miles from Bridge River Station on the Pacific Great Eastern Railway.

The deposits are enclosed within the Bridge River series, the *Minto* ground being largely underlain by sedimentary rocks, chiefly argillites and cherty quartzites, intercalated with greenstones. The general trend of the rocks is northerly to north-westerly, rock-structures being complex. Cutting the series there are several dykes, striking northerly with steep dips, types noted including feldspar porphyry, andesite porphyry, and a highly-altered, fine-grained, slightly porphyritic basic variety. The *Minto* dyke, considered to have had an important structural influence on the localization of ore-shoots, is a dark, fine-grained, altered intrusive up to 20 feet wide.

Mineralization, consisting of arsenopyrite, pyrite, stibnite, pyrrhotite, sphalerite, galena, and occasional chalcopyrite, is associated with quartz and calcite and, in places, conspicuous green chlorite. The deposits occur in a fault-fissure chiefly in the sedimentary rocks along the foot-wall of the *Minto* dyke. The fissure strikes about north and dips 75 to 80 degrees east. The principal values are in gold with minor amounts of silver. Where the fissure trends away from the dyke it has been less regular and mineralization has not been as strong, the productive sections of the fissure having been found in the part contiguous to the dyke which forms a clean hanging-wall to the ore-shoots. The foot-wall is less definite, stoping-widths, generally varying from 3 to 5 feet, being determined by assay-widths. Greenstone lies immediately to the west of the sediments, as exposed in crosscuts, but is entered by the fissure at a few points as at the inner extremity of the uppermost or *Warren* adit and towards the northern faces of the two deepest levels. At the two latter horizons the greenstone is more or less leached and carbonatized and slightly mineralized.

Little work had been done on the property prior to 1930. At that time it was owned by W. A. Davidson and was being explored, under option, by the Consolidated Mining and Smelting



Minto Gold Mines, Ltd. Longitudinal Section showing Stoped Areas. From Company's Plan.

Company of Canada. Work done by this company in 1931 included driving the *River* adit to a point 350 feet in from the portal to the south fault and about 50 feet of crosscutting westerly from a point beyond it. Subsequently the option was relinquished and in 1933 the property was acquired by the present operators. A 50-ton mill was put into operation in 1934 and has since been stepped up to a rated capacity of 125 tons. Past references to the property, under *Alpha* group, are contained in the Report of the Minister of Mines for 1930, 1931, 1932, and Bulletin No. 1, 1932, "Lode-gold Deposits of B.C.," and under "Minto Gold Mines" in the *Report of the Minister of Mines for 1933. The accompanying longitudinal section shows the* stoped areas as at the end of September, 1936.

Surface workings include two open-cuts in a northerly-trending ravine at elevations of 2,531 and 2,468 feet. These expose widths, up to 8 feet, of sheared weathered material, including oxidized decomposed streaks against a sharply-defined hanging-wall formed by the *Minto* dyke, which here dips at 80 degrees to the east. *Immediately adjoining the lower* showing to the west a small patch of cherty quartzite is exposed. The vein, completely oxidized, is partially exposed at the portal of the *Warren* adit, its relationship to the dyke being similar. On the surface, chaining to east and west of the portal, a section of the exposed rocks is as follows: Beyond the dyke going east there is soil to 33 feet; quartzite from 33 to 39 feet; the rocks are covered by soil and boulders from 39 to 71 feet; greenstone from 71 to 85 feet; quartzite from 85 to 99 feet; highly-altered, fine-grained, slightly porphyritic dyke from 99 to 104 feet; and finally quartzites from 104 to 124 feet to where the formation is again covered. A specimen from an outcrop of medium-grained crystalline rock, containing abundant biotite, up the hill from, and a short distance to the north of, the section 71 to 85 feet was examined microscopically. It was found to be composed of a mosaic of quartz grains and contained abundant biotite as flaky aggregates and laths of fair size. In the former case the biotite was often associated with a tabular to fibrous amphibole, probably anthophyllite, which was abundant in the section. A few fresh crystals of oligoclase were present and minor amounts of yellowish apatite and chlorite.

The underground workings comprise a total footage of over 7,000 feet distributed in five levels, the upper four of which were formerly known as the *Warren, Hagmo, Main,* and *River* adits, at respective elevations of 2,386.13, 2,275.91, 2,091.55, and 2,010 feet. From top to bottom these have been renamed 100, 200, 300, and 400 levels, and the new deepest working, reached by winze from the 400 adit, is known as the 500 level at 1,875 feet elevation. The 100 adit, 510 feet long and containing three crosscuts aggregating 45 lineal feet, is a drift north on the vein and dyke up to a point 27 feet back from the face where both are cut off by a pronounced fault striking north 73 degrees west and dipping north-easterly at 55 degrees as exposed in the eastern wall of the drift. On the western wall the fault dips easterly at a flat angle, being dragged around to another fault-plane, marked by gouge, which strikes north 6 degrees west and dips easterly at 75 degrees. South of the first fault the vein-fissure is in greenstone, but immediately north of it argillaceous quartzite is exposed along the eastern wall of the drift. In the 5-foot length between the second fault and the face, normal greenstone is exposed as *compared with the highly-altered, buff-coloured greenstone to the south of the southern fault.* Paralleling the strike of the northern fault, and 3 feet easterly from it, there is a vertical band, from 16 to 18 inches wide, of quartz and calcite mineralized with pyrite. Two samples across this showing, one in the eastern wall of the drift and the other in the back 4.5 feet southerly, across the widths specified assayed respectively: Gold, 0.28 oz. per ton; silver, trace; and: Gold, 0.26 oz. per ton; silver, 0.35 oz. per ton. A selected sample of this mineralization assayed: *Gold, 0.24 oz. per ton; silver, 0.4 oz. per ton. The 3-foot section of pyritized, sheared, altered* rock, containing numerous calcite-streaks, between the 16-inch sample and the northern fault, assayed: Gold, 0.04 oz. per ton; silver, 0.2 oz. per ton. A sample across the main vein, 5.5 feet wide, just south of the southern fault, assayed: Gold, 0.10 oz. per ton; silver, 0.8 oz. per ton. The above-described faulted condition was not correlated in the deeper levels. The end of this adit marks the approximate northern extremity of stoping done in the mine below. A limited amount of exploration in this location might afford information bearing on the north end of the mine on this and other levels. In the stoped area, about 235 feet in from the portal of the 100 level, another fault, striking east-west and dipping north at 49 degrees, causes a displacement of 10 feet to the west going north along the drift. This fault is reported to continue to the 200 and 300 levels, causing similar displacements.

The 200-level adit, driven northerly, is 1,160 feet long and contains crosscuts aggregating 300 lineal feet, the longest of which extends 120 feet east at a point 20 feet back from the face. North of a point about 670 feet in from the portal, the workings on this level were in bad shape for examination due to caving of the sheared ground and backing-up of water. Beyond the northern end of the stoped area shown on the section conditions are indefinite, the altered rocks being sheared along planes paralleling the general attitude of the fissure. Occasional low assays are said to have been obtained for some distance north of the point specified.

The 300-level adit comprises about 2,000 lineal feet of workings, approximately half this footage being distributed in crosscuts. The adit is driven north-westerly to the mineralized fissure, the deposits being encountered on the north side of a strong post-mineral fault, known as the south fault, which strikes north 75 degree west and dips northerly at about 50 degrees. To the south of this fault the fissure has been displaced 250 feet to the east. Northerly from the stoped section on the 300 level conditions are indefinite. The sheared ground has caved in places and dammed up water, making examination difficult. The 400-level adit is driven 350 feet north on the fissure to the south fault. The fissure is strong and well mineralized in places, the average gold values being low. In this 350-foot section the *Minto* dyke lies on one or other wall or is split by the fissure. From a point north of the south fault a crosscut is driven westerly to where the mineralized fissure is encountered on its projected dip below the 300 level, the same dyke forming the hanging-wall at this lower horizon as at other productive points in the mine. The fissure is followed north from the fault, the first short drift being extended in March, 1936. Values improved at a point about 46 feet north of the intersection and, at the end of March, channel samples were taken by the writer at 5-foot intervals over a length of 152 feet or to a point 198 feet from the crosscut. These gave an average assay of: Gold, 1.66 oz. per ton across 4.9 feet, including a section 100 feet long, which assayed 2.09 oz. gold per ton across 5.25 feet. At the end of September this drift had been advanced to a point about 440 feet from the crosscut. Similar sulphide concentrations, separated by short sections of light mineralization, persisted to a point 330 feet from the crosscut, over an average width of over 5 feet. The dyke and vein relationships are normal throughout the above drift section, but towards the face the mineralized fissure, splitting the dyke, narrowed to 1 foot in width. Southerly from the crosscut the drift was extended back about 50 feet to the south fault. As shown on the section, a winze was sunk 143 feet on the dip of the fissure to the 500 level, where the south fault was encountered. The heavy sulphide mineralization continued down the winze to between 35 and 40 feet below the collar. The 500 level comprises about 400 lineal feet of work, of which 350 feet consists of a drift north of the winze-bottom. In this working the *Minto* dyke forms the hanging-wall of the mineralized fissure to a point about 50 feet back from the face. The dyke is silicified and mineralized in places along the wall and in the first 60-foot section north of the winze, where it is partly included in the fissure as a "horse" up to 5 feet wide. In the 300-foot length specified mineralization is generally similar to the material stoped above the 300 level with some sections of sulphide concentrations, no continuous showing of high-grade, as on the 400 level, having been encountered. In the last 50-foot section back from the face, where the dyke is not in evidence, the fissure narrows and mineralization is sparse. South of the winze-bottom the drift was extended through the south fault for about 45 feet and a raise put up to the 400 level, connection being made with an existing raise from the 400 to the 300 level, facilitating hoisting to the main working-adit leading to the mill.

A station was cut and preparations were being made for a working-shaft at the point indicated on the illustration to be sunk below the 400 level and continued up as a raise to a crosscut which extends about 440 feet north-easterly from the main or 300 level. The shaft location is centrally situated for exploration on both sides of this fault at deeper horizons.

Reward Mining Co., Ltd.

This company's *Dauntless* prospect, in the Lillooet Mining Division, is stated to consist of fifty-four mineral claims held by location, in which an option to a 75-per-cent. interest was acquired early in 1936 by the Reward Mining Company, Limited, from the Federal Gold Mines, Limited. The holdings lie to the north-east and east of the *Minto* property, the workings examined being on the *Dauntless No. 2* claim, near its western boundary, which is located a few hundred feet east of Mowson Lake. This lake and the *Minto* property are shown on B.C. Department of Lands mineral reference map 21T269, the area now occupied by the *Dauntless No. 2* claim being indicated as the *Peerless No. 2*, under which name this ground was formerly held.

The camp at 2,149 feet elevation, and workings at from 2,256 to 2,356 feet elevation, are on the south-western side of a narrow valley occupied by a dry creek-bed which extends south-easterly from the Mowson Lake vicinity to Bridge River at 2,000 feet (assumed elevation). The adit, and neighbouring camp on the *Peerless* claim, are connected by branch road, 1,800 feet in length, extending north-westerly from the highway at a point about 34 miles from Bridge River Station on the Pacific Great Eastern Railway. Backed by a low ridge separating the *Reward* claims from the *Minto* property, the workings are situated on the north-easterly slope, of about 25 degrees, to the valley-floor, at 2,200 feet elevation. Beyond this depression the ground rises steeply to the north-east. The country is generally open, the scattered trees consisting of pine and fir up to 18 inches in diameter. The overburden is generally deep, or from 10 to 12 feet thick on the south-western side of the valley and up to 200 feet thick to the north-east. Outcrops are comparatively scarce and the deposits were found by ground-sluicing following constructive and systematic prospecting of the local dyke system.

The area is underlain by rocks of the Bridge River series, local exposures consisting of quartzites, cherty in part, argillites, and intercalated greenstone. The formation, striking north-westerly and dipping south-westerly from 65 to 75 degrees or vertical, is cut by numerous dykes of felsite, feldspar porphyry, and quartz porphyry, from 10 to 100 feet in width. Of these, a wide, northerly-striking feldspar-porphyry dyke cuts the sediments just west of the workings.

The principal showing, being developed by the drift-adit, is in siliceous sediments which include small irregular patches of altered greenstone. It is associated with a well-defined shear-zone, 8 to 13.7 feet wide, striking north 52 degrees east, thus crossing the strike of the formation at a wide angle. Dips are north-westerly at angles of from 80 to 87 degrees, the hanging-wall fracture being marked by gouge from a seam to 2 inches thick. The adit is driven south-westerly, in which direction the shearing should continue in sediments to the *Reward* boundary, a little over 200 feet from the portal. About 100 feet north-easterly from the portal it should enter a large body of greenstone, the company's holdings in this direction being extensive. The writer's samples indicate low but consistent gold values over accessible exposures from 8.5 to 13.7 feet wide. Within the hanging-wall and foot-wall fractures, which have diverged in strike going south-westerly, the mineralization is made up of: (1) A band along the foot-wall, 2.5 to 5 feet wide, consisting mainly of calcite with small amounts of arsenopyrite, pyrite, and stibnite; and (2) irregular masses of altered greenstone and sediments, containing finely-disseminated pyrite and arsenopyrite, and intersected by numerous streaks and veinlets, up to 2 inches wide, of quartz and calcite sparingly mineralized with the same sulphides. The shear-zone in general carries a small proportion of metallic minerals, the average percentage of stibnite being much smaller than in neighbouring mines. A polished section of selected mineralization, examined under the microscope, consisted of arsenopyrite, in a fine-grained crystalline form, disseminated, commonly in rough bands, through a quartz gangue containing abundant minute needles of stibnite. This mineral also forms relatively large irregular masses associated, in places, with a carbonate gangue-mineral. A few grains of pyrite were noted. In the section examined the arsenopyrite-stibnite association is not, in general, an intimate one and it is probable that a separation could be made. Fine crushing of similar material would be necessary to release the sulphides from the gangue.

The property has no history of consequence, the deposits of interest being recent discoveries.

Surface work on the shear-zone is limited to an exposure of oxidized siliceous material in ground-sluicing done just above, and south-westerly from, the portal of the adit. This had been driven 42 feet to September 29th, 1936, exposing the shear-zone over a width of from 8 feet at the portal to 13.7 feet at the face. Close timbering extended for a length of 22 feet in from the portal, preventing sampling in this section, where, however, strong sulphide mineralization is visible in places between the lagging. The face was sampled in three sections, from foot to hanging wall, assays being as follows: (1.) Across 4.2 feet: Gold, 0.20 oz. per ton; silver, 0.2 oz. per ton; arsenic, trace; antimony, trace. (2.) Across 4.5 feet: Gold, 0.10 oz. per ton; silver, 0.1 oz. per ton; arsenic, 0.2 per cent.; antimony, *nil*. (3.) Across 5 feet: Gold, 0.02 oz. per ton; silver, trace; arsenic, 0.2 per cent.; antimony, *nil*. At 33 feet in from the portal the vein was sampled in two sections, from foot to hanging

wall, as follows: (1.) Across 31 inches: Gold, 0.06 oz. per ton; silver, trace. (2.) Across 75 inches: Gold, 0.07 oz. per ton; silver, trace. A muck sample taken from the same place, before the face had been advanced, assayed: Gold, 0.10 oz. per ton; silver, trace. At 22 feet in from the portal, and at the end of the lagging, the vein was sampled in two sections, from foot to hanging wall, as follows: (1.) Across 5.5 feet: Gold, 0.14 oz. per ton; silver, trace. (2.) Across 3 feet: Gold, 0.26 oz. per ton; silver, trace. Selected mineralization from this working assayed: Gold, 0.56 oz. per ton; silver, trace. The channel samples indicate that low average gold values are contained throughout the exposed portion of the shear-zone. While these are below commercial grade, they are of interest in view of the width and apparent strength of the shear-zone and the possibility that better-grade material might be encountered in further development. To explore the shear-zone north-east of the adit it will be necessary to sink before drifting, due to the exceptionally heavy overburden in this direction.

Other mineral occurrences, in quartzite, are as follows: At 2,326 feet elevation and 180 feet west of the adit-portal a showing has been traced for a length of 50 feet, of which 30 feet has been stripped. This consists of a zone of quartz and calcite stringers, from 12 to 18 inches wide, associated with fracturing striking north 10 degrees east, with an easterly dip of 75 degrees or vertical. A selected sample of the mineralization, which consists chiefly of pyrite with occasional sphalerite, assayed: Gold, 0.06 oz. per ton; silver, trace. The outcrop is covered at both ends. Fifteen feet to the east a parallel, similar narrow occurrence, lightly mineralized with pyrite, is exposed. At 2,356 feet elevation and 280 feet west of the adit-portal, ground-sluicing has exposed a lenticular showing, up to 10 inches wide, of banded quartz and calcide containing massive pyrite-streaks with occasional sphalerite and galena. A sample across 6 inches assayed: Gold, trace; silver, trace. The lens strikes north 10 degrees west, with a westerly dip of from 40 degrees to 50 degrees.

The property is equipped with a 2-drill compressor plant at the mine portal and camp buildings include three small bunk-houses and a cook-house.

Reliance Gold Mines, Ltd.

The property of this company, in the Lillooet Mining Division, consists of eighteen mineral claims and fractions held by location, of which sixteen have been surveyed. The precise location of the *Reliance* group is shown on B.C. Department of Lands Mineral Reference Map 21T269, on the southern side of Bridge River opposite the *Stibnite* group, now *Congress* mine. The wooded ground slopes steeply to the river and the principal workings, at elevations varying from 2,175 to 3,655 feet, are situated on a ridge trending north-north-west between Camp Creek to the west and a small unnamed creek to the east. The property is reached by a suspension bridge, recently constructed by the company, and half a mile of road traversing the flats (2,140 feet elevation) north of the river and connecting with the highway at a point about 37 miles from Bridge River Station on the Pacific Great Eastern Railway. The camp and compressor plant are situated on the flat ground north of the river.

The *Reliance* group is in an area of the Bridge River series, consisting of greenstone and sediments forming alternating, northerly-striking belts of varying width. In the case of the *Reliance* no dykes were observed in the developed area, but there is said to be a feldspar-porphyry dyke exposed in outcrops on the *Ophir* and *Banker No. 5* claims at the south-eastern corner of the property adjoining the 4,500-foot contour. The workings examined are at widely separated points along the previously mentioned ridge, which is largely composed of greenstone. This belt, which includes phases of purple volcanic rock bordering the sediments, is about 1,400 feet wide near the river and 1,000 feet wide at the upper workings.

The deposits are associated with fracturing and shearing cutting the greenstone along variable strikes and dips. In the *Fergusson* and *Turner* adits, described later, the strikes vary from north 55 degrees east to north 80 degrees east, with north-westerly and northerly dips of from 65 degrees to approximately vertical. At the uppermost workings strikes are from south 40 degrees east to south 55 degrees east, with north-easterly dips of 80 degrees. Adjoining fractures, the rocks are frequently silicified with, in places, an incipient development of the finely-mineralized ankeritic-carbonate alteration typical of the *Congress* deposits. Stibnite is the most prominent mineral, occurring in streaks, disseminations, or narrow bands in a siliceous gangue, frequently oxidized, with occasional quartz and calcite. The stibnite vein-like occurrences are generally associated with the more indefinite type of mineralization

consisting of fine specks of pyrite and occasional arsenopyrite either disseminated or in minute seams. The writer's channel samples show generally less than 0.1 oz. gold per ton over widths up to 5 feet, the assay in one case being 0.26 oz. gold per ton across 1.8 feet. Silver values were from a trace to 0.2 oz. per ton. The largest stibnite-showing is 81 feet long and varies in width from a seam to 6 inches, a selected sample assaying: Gold, trace; silver, trace; antimony, 58.8 per cent.

The property is mentioned briefly in Geological Survey of Canada Memoir 130, "Geology and Mineral Deposits of the Bridge River Map-area," published in 1922, and in the Report of the Minister of Mines for 1933. In the latter year the company, a Washington incorporation, was registered in British Columbia, and most of the development-work has been done since. Among other improvements made during 1936, a Gardner-Denver compressor plant was installed, an office and other small buildings were erected at the camp-site, and a suspension bridge was constructed over the river.

Commencing at the uppermost workings and descending the steep ridge, conditions are as follows: At 3,655 feet elevation and on the edge of the abrupt slope to Camp Creek, an open-cut exposes a sheared oxidized zone, from 2 to 3 feet wide, striking south 40 degrees east, with a north-easterly dip of 80 degrees. Here a sample across 3 feet assayed: Gold, 0.08 oz. per ton; silver, trace. Directly below this open-cut to the north-west, the *Old Reliance* adit, at 3,625 feet elevation, has been driven south 55 degrees east for 23 feet along the same shear, the dip being similar. Going north 17 degrees east for 100 feet from the adit-portal, and at the same elevation, trenching exposes vertical shearing striking south 17 degrees west in rusty partially-decomposed greenstone, solid rock just having been reached.

The *Fergusson* adit, at 3,357 feet elevation, is 630 feet north 34 degrees west from the *Old Reliance* adit-portal. At 3,380 feet elevation, directly above the portal of the *Fergusson* adit, the ground flattens where a trench, 5 feet wide, from 8 to 15 feet deep, and 100 feet long, extends along a bearing of about north 75 degrees east. Conditions were obscured by debris in the floor of the trench. From this working a shipment of sorted stibnite is reported to have been extracted in 1917, but no record of this has been found. The adit below is driven as follows: From A at the portal east for 35.8 feet to B; north 72 degrees east for 45.5 feet to C; south 45 degrees east for 12.75 feet to D; and north 55 degrees east for 27 feet to the face. From C a branch is driven north 45 degrees west for 7.5 feet. The vein, 4 feet wide, and standing approximately vertical, is followed in the drift sections A to C and D to E, the offset from C to D being caused by displacement along a fault striking south 45 degrees east and dipping at from 65 to 70 degrees to the south-west. From A to C there is practically a continuous streak of stibnite from a seam to 6 inches wide, the gangue being siliceous with some calcite and shattered quartz. Adjoining the stibnite fracture on one or both sides in places, the greenstone is altered and contains finely disseminated sulphides, this mineralization being indefinite. Similar conditions apply to the drift section D–E, where, however, the stibnite is in discontinuous streaks. The following samples were taken: (1.) Selected stibnite, with a little quartz, from the A–C showing, assaying: Gold, trace; silver, trace; antimony, 58.8 per cent. (2.) Across 22 inches at 18 feet in from the portal at A, assaying: Gold, 0.26 oz. per ton; silver, 0.1 oz. per ton; antimony, 9.1 per cent. (3.) Across 32 inches at C, assaying: Gold, 0.06 oz. per ton; silver, 0.2 oz. per ton; antimony, 3.3 per cent. (4.) Across 46 inches at E, assaying: Gold, 0.02 oz. per ton; silver, trace; antimony, trace.

The *Turner* adit, at 2,721 feet elevation, is 1,050 feet north 58 degrees west from the portal of the *Fergusson* adit. It was being advanced by hand at the time of the writer's examination in August, 1936, and had been driven first as a crosscut south 45 degrees east for 86 feet, then as a drift on the shear north 73 degrees east for 27 feet. In the crosscut section the greenstone-walls grade into purple volcanics in places as at the portal and on the south-west side of the working near the sharp bend, but the drift is all in greenstone. The shear, up to 5 feet wide, is associated with irregular fracturing striking north 80 degrees east, with northerly dips of from 65 to 80 degrees. From hanging-wall to foot-wall a section sampled in the face consisted of: (1) 14 inches of sheared, oxidized, partly-decomposed greenstone containing a thin streak of stibnite underlying a fracture dipping northerly at 80 degrees; (2) 26 inches of altered silicified greenstone containing disseminated sulphide specks; (3) 3-inch oxidized decomposed streak underlain by fracture dipping northerly at 65

degrees; (4) 12 inches of altered silicified greenstone containing scattered sulphide specks. The fractures adjoining Nos. 1 and 3 sections were converging in strike as well as in dip. A sample across the whole width of 55 inches assayed: Gold, 0.02 oz. per ton; silver, trace. A sample across 5 feet, where the shear was first encountered at 80 feet in from the portal, assayed: Gold, trace; silver, trace; antimony, *nil;* arsenic, *nil.* A grab sample from a pile of sorted antimonial material at the portal assayed: Gold, 0.05 oz. per ton; silver, 0.05 oz. per ton; antimony, 14.5 per cent.; arsenic, *nil.*

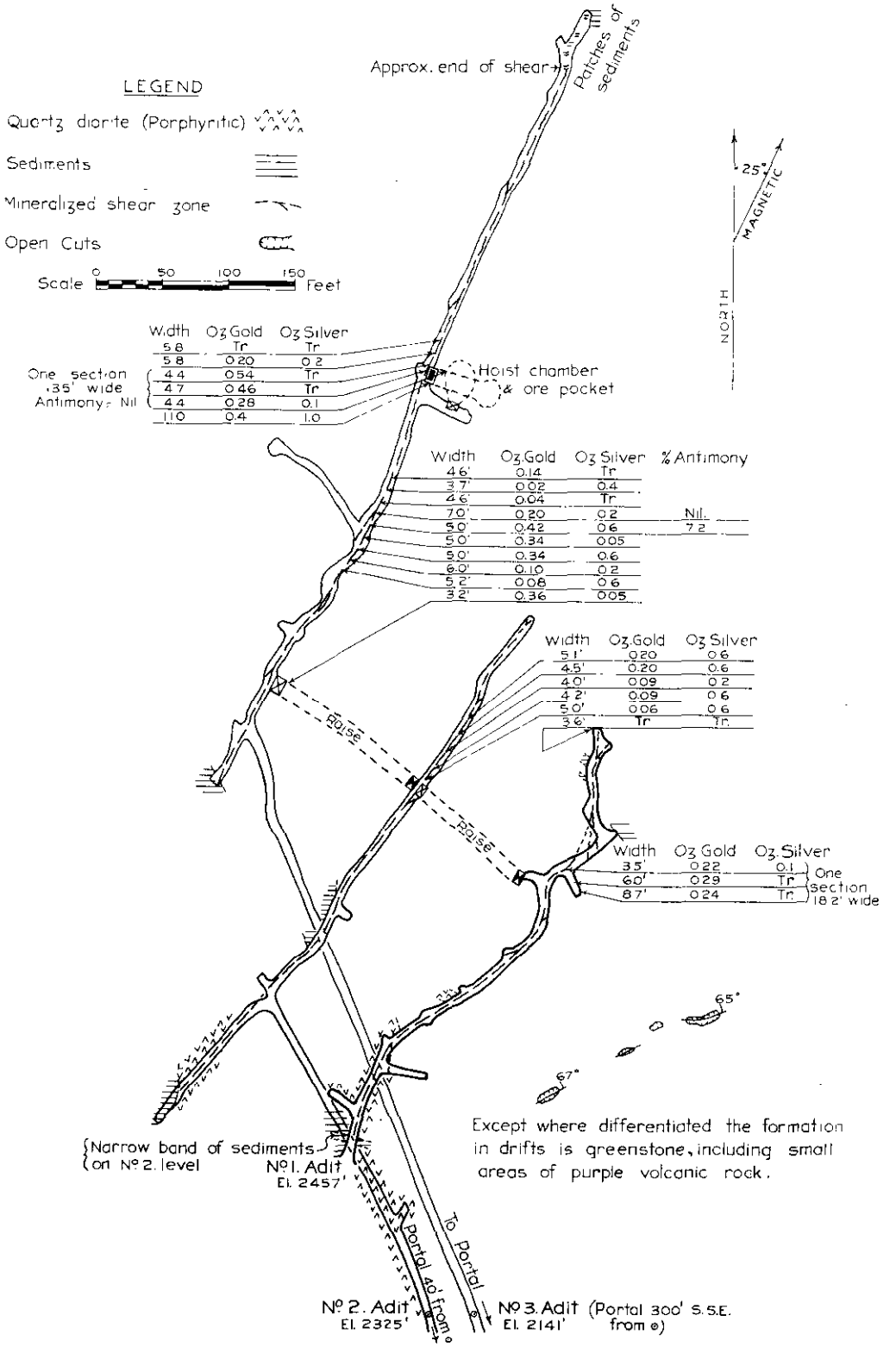
Along the strike of the shear, in the opposite direction from the drift, sediments are exposed adjoining Camp Creek about 175 feet away. The *River* adit, at 2,175 feet elevation, is about 950 feet north 11 degrees east from the *Turner* adit portal and about 50 feet above the river-level. It is a crosscut which, to August 26th, 1936, had been driven south 11 degrees east for 123 feet, its main objective being the shear in the *Turner* adit. This working, then being advanced with a machine, was in greenstone with included patches of purple volcanic rock. In addition to the workings specified, there are several open-cuts exposing fracturing or zones of shearing striking across the trend of the greenstone, but conditions are too indefinite for individual description at the present stage.

Congress Gold Mines, Ltd.

This company's property, in the Lillooet Mining Division, consists of twenty-three mineral claims and fractions held by location, which extend from Bridge River northerly across Gun Creek. The precise location of the property is shown on B.C. Department of Lands Mineral Reference Map 21T269. The main workings, at elevations of from 2,141 feet to 2,565 feet, are on the sparsely-wooded, open ground sloping steeply to Bridge River. The mine buildings, below the workings, adjoin the highway at a point 37 miles from Bridge River Station on the Pacific Great Eastern Railway, or about 1,500 feet westerly from the Gun Creek Bridge.

The formations underlying the *Congress* holdings are mainly greenstone and sediments of the Bridge River series. These rocks are irregularly intruded by much younger dykes and small stocks, including felsitic varieties and porphyritic quartz diorite. An altered intrusive body of the latter type, 60 feet wide or more, striking north-westerly, with generally steep south-westerly dips, is cut by the main fissure in the upper two levels. The greenstones and argillaceous sediments form alternating northerly-striking belts of varying width, rock-structures being complex.

The mineral deposits developed by the main workings follow a sheared fissure up to several inches in width, which varies in strike and dip and in places splits into two or more fractures. The strike of the main shear is north-easterly, dips being north-westerly at angles of from 35 to 57 degrees. It is well defined through the quartz-diorite porphyry and the greenstones, but where the shear encounters the sediments, as at the south-western extremity of the No. 2 level drift and both ends of the No. 3 level drift, it becomes obscure or is dissipated. Mineralization is best developed where the shear cuts greenstone which in places, as when approaching the sediments, grades imperceptibly into purple volcanic rock. In the latter rock mineralization is less pronounced and values are lower. The principal type of deposit consists of replacement of greenstone, the wall-rocks along the main shear being altered to a dense, tan-coloured, ankeritic carbonate with which is associated varying amounts of dense to finely crystalline quartz. This zone of alteration, which generally grades into normal greenstone without definite lines of demarcation, is from 2 to 30 feet wide, irregularly distributed on either side of the shear, the larger widths occurring in flat rolls or where the fissure splits into several fractures. The altered rock has a mottled appearance due to the presence of dark "hair-line" streaks and films of fine-grained sulphide aggregates, including pyrite, arsenopyrite, with rarely sphalerite. This mineralization, which at points, as on the No. 3 level, is more coarsely crystalline, diminishes in intensity outwards from the shear which serves generally as a central marker, assay-widths varying from 3.5 to 18.2 feet. Associated with this finely-mineralized zone, and following its main fissure and subsidiary fractures, are streaks and elongated lenses of stibnite, up to 6 inches in width and 25 feet in length, frequently associated with quartz. The stibnite occurs in massive or banded form and is from fine-grained to coarsely columnar in structure. It is occasionally coated with cherry-red films of the oxidation product kermesite. Small cinnabar occurrences have been definitely recognized at points in the upper two levels. Gold values, chiefly associated with the replacement mineralization in the greenstone, are generally low, but consistent, with a distinct tendency to improve



Congress Gold Mines, Ltd. Plan of Workings. After Company's Plan.

at depth as on the No. 3 level, where average widths are also greater. At this horizon, where there is apparently more arsenopyrite, stibnite is less in evidence, average percentages of the latter mineral being, according to the management, appreciably lower than on the No. 2 level, where it reaches its maximum development. Large sampling operations, beyond the scope of the writer's examination, would be necessary to determine average values. Twenty-three channel samples, taken for information, gave assays from a trace to 0.54 oz. gold per ton and from a trace to 1 oz. silver per ton, widths being from 3.5 to 18.2 feet normal to the dip. One section, 5 feet wide, typical of strong stibnite mineralization, assayed 7.2 per cent. antimony.

The nucleus of the property was formerly known as the *Stibnite* group, located by E. J. Taylor and J. Shuster. It was relocated in 1915 by C. H. Allan and associates, a small amount of underground work having been done in the same year. Subsequently the property was acquired by T. Turner and in 1933 was transferred to the present company, since when most of the development-work has been done. References to the *Congress* mine are contained in the Report of the Minister of Mines for the years 1933, 1934, and 1935.

During the period under review the principal work consisted in putting up a raise from the No. 3 to the No. 2 level and cutting a station, with hoist-raise and ore-pocket, preparatory to sinking a 2-compartment main inclined winze. A new 4-drill Sullivan compressor was installed, electrically driven by the local commercial power. The mine-workings are shown on the accompanying plan. Of the four open-cuts on the drift-covered steep slope above No. 1 adit, the two central ones are caved. The two outer cuts expose widths of from 6 to 7 feet of weathered, mineralized greenstone associated with north-easterly-striking shearing and accompanying stibnite-quartz-filled fractures. The underground workings comprise Nos. 1, 2, and 3 levels at corresponding elevations of 2,457, 2,325, and 2,141 feet. The No. 3 adit, or main working-level, is about 40 feet above the highway. No. 1 level is a drift on the shear, 402 feet from the portal, while the Nos. 2 and 3 level drift sections, 473 and 650 feet long respectively, are reached by crosscuts. Connecting raises extend between the three drifts as shown.

Conditions underground in regard to exposed widths of the more definite mineralization are briefly described in the following notes. Unless specified, the formation is composed of greenstone, including patches of purple volcanic rock, not differentiated. Chaining from the portal of the No. 1 adit the average width is 4.9 feet between 22 and 262 feet. Up to chainage 80 feet the shear cuts porphyritic quartz diorite, sediments being exposed on the southern wall of the drift between the portal and the first crosscut. In the irregular triangular area of drifting just beyond chainage 262 feet, where the shear splits into several fractures, widths of altered mineralized greenstone are up to 20 feet or more. Three samples in the south-easterly crosscut here averaged 0.25 oz. gold per ton across 18.2 feet. In the last 80 feet back from the face the average width is 5.3 feet and in this section there are scattered patches or narrow bands of sediments as along the north-western wall and in the face.

Near the south-western extremity of the No. 2 level drift the shear ends where it encounters sediments. Going north-westerly from this face, the shear cuts the quartz-diorite-porphyry dyke between 16 and 99 feet, widths of mineralization in this section being from 2 to 3 feet wide. From the latter point the shear persists to the north-eastern face, the average width of mineralization being about 4 feet. In the drift adjacent to the main crosscut small areas of sediments are exposed on one or other side of the sheared, mineralized greenstone.

At the south-western extremity of the No. 3 level drift the shear terminates in sediments. Going north-westerly, the average width is 5.5 feet to the end of the shear 58 feet back from the north-easterly face, exclusive of the wide section adjoining the winze-site, where three samples averaged 0.427 oz. gold per ton, and antimony *nil*, across 13.5 feet, and another sample across 11 feet, at 10 feet south-westerly, assayed 0.40 oz. gold per ton. In the 58-foot length measured back from the north-easterly face the fissure is not present, the formation here being chiefly purple volcanic rock with patches of sediments. Diamond-drilling was done from the three levels to outline the widths of altered mineralized greenstone on either side of the main shear and to explore the adjoining formation for varying distances up to 200 feet from it. Stibnite occurrences are reported to have been discovered by prospecting and superficial work done at other points on the property, and a new adit has been started at a point 1,200

feet east of the *Congress* workings to intersect a mineralized shear, approximately parallel with the one developed in the mine, which outcrops in greenstone bluffs above.

Taylor Basin Area.

Goldside Mines, Ltd.

This company's option on the *Northern Light* group, described on page F 13 of the Report of the Minister of Mines for 1935, has been relinquished, and new work done is on the *Lucky Strike* group of seven claims which was acquired by option late in 1935, and subsequent to the writer's first examination. Including the *Lucky Strike* group, the holdings of the Goldside Mines, Limited, are now stated to consist of thirty-one mineral claims and fractions. The claims are situated within and adjacent to Taylor Basin at the head of Taylor Creek, a tributary of Tyaughton Creek, which in turn flows into Bridge River. The mine camp, located 1,600 feet measured south 30 degrees west from the forks of Taylor Creek 4 miles above its mouth, is situated on a wooded knoll adjoining the creek at about 6,050 feet elevation. The boundaries of the basin consist of broad, smoothly-rounded, bare ridges rising to elevations of about 8,000 feet; the upper slopes being covered with talus and rock-slides through which emerge rugged outcrops of rock. The middle slopes, covered by a heavy mantle of glacial drift, are traversed by snow-fed creeks and are covered by a shrub-like growth of balsam-fir, together with a rank growth of grass and wild flowers. The low areas along the creek and basin are well wooded with balsam-fir and occasional spruce. The summits to the north and south of the basin rise to elevations of about 8,000 feet. The new adit on the *Lucky Strike* ground, and at elevation 6,275 feet, is situated about 1,400 feet south-westerly from the camp, which is on the edge of timber-line.

The surface workings, at elevations of from 6,600 to 6,610 feet, are on both sides of an easterly-westerly-trending ridge, just below its apex. The ground slopes steeply to north and south, the adit-crosscut approach being driven into the base of the ridge from its southern side.

Until recently the Taylor Basin prospects were reached by pack-trail from 8 to 9 miles in length, which branches off the road near the south-western extremity of Tyaughton Lake. This road, about 3.5 miles in length, leaves the Bridge River Road east of the Pearson ponds at a point about 33.5 miles from Bridge River Station on the Pacific Great Eastern Railway. The trail climbs from about 3,200 feet elevation at the lake to 6,950 feet (revised elevation) at the Taylor Basin Pass in a distance of about 6 to 7 miles. From the latter point the trail, about 2 miles in length, descends to the *Goldside* camp, passing the *Lucky Strike* adit en route. At the time of the writer's last visit, in September, 1936, a crew was employed by the company on the construction of a road extending from the end of the existing branch road first along the north-western side of Tyaughton Lake, then along the high ground bordering the western side of Tyaughton Creek to Cinnabar Creek, and finally north-westerly to Taylor Creek, its north-western side being followed to the camp, a total distance of about 14 miles, of which 11 miles has been completed (to a point 3 miles below the camp).

The oldest underlying rocks exposed consist of highly-metamorphosed sediments of the Bridge River series. Next in ascending order are serpentines of the Shulaps volcanics and the Eldorado series, referred to the Lower Cretaceous, which are locally represented by outcrops of argillite, grey feldspathic sandstone, and conglomerates. Intruding the last-mentioned series are large bodies of diorite mapped as being related to the Bendor batholith. The writer's 1935 report was chiefly concerned with the narrow quartz-arsenopyrite veins in this diorite. In the new workings, on *Lucky Strike* ground, geological conditions are complex, the rocks being highly metamorphosed and structures difficult to determine. At the present stage of exploration it is not possible to definitely correlate conditions on the surface and underground. The deposits occur as lenses along the walls of dykes cutting serpentine and altered rock consisting largely of ferruginous carbonate. The dykes, striking northerly with steep westerly or vertical dips, are from 4 to 10 feet wide. At underground points the dyke is fine-grained and porphyritic, and a specimen, examined under the microscope, consists of a highly-altered complex of sericite, chlorite, and feldspar. Phenocrysts of feldspar were largely altered to white mica; some granular epidote is present in places, together with a very little quartz, probably secondary. Pyrite is disseminated through the rock associated in places with pale chlorite. The specimen is tentatively classified as an altered latite porphyry. Another specimen, examined megascopically, consists of leached, carbonatized, and mineralized rock of indecipherable origin. To the south of the dyke, in the crosscut-approach section, there

are irregular areas of hornblende diorite, a medium fine-grained holocrystalline, greenish rock. A specimen of comparatively fresh material, examined under the microscope, consists of plagioclase (andesine) 80 per cent. and hornblende 20 per cent., the whole rock being highly chloritized. Both white mica and epidote are present. The hornblende diorite merges without definite boundaries into a dense dark rock with green serpentinized phases.

The mineralization consists mainly of sulphide streaks and masses occurring in irregular lenses on one or both sides of the dykes, also penetrating them in places. The gangue is generally silicified altered rock, with minor amounts of quartz and occasional calcite, the sulphide-masses at underground points frequently being associated with a bright-green chlorite mineral. Two polished sections were examined microscopically. In the first case the minerals noted in order of abundance are sphalerite, jamesonite, pyrite, and chalcopyrite. Sphalerite and jamesonite form relatively large irregular masses, in places rather intimately associated. Pyrite occurs as cubes up to 2 mm. in size, fractured in places and veined by the other sulphides. Chalcopyrite was noted only in ex-solution blebs in sphalerite. No. 2 section is composed of massive to crystalline arsenopyrite in a quartzose gangue. Fourteen channel samples showed gold values of from 0.12 to 1.30 oz. per ton and silver values of from 0.1 to 6.0 oz. per ton. Sampling-widths varied from 4 inches to 7.5 feet.

The *Lucky Strike* claims were staked by Jack McPhail, the only previous mention of the property being in the Report of the Minister of Mines for 1933. Surface showings on the steep southerly slope of the ridge are at elevations of from 6,575 to 6,620 feet, the top of the ridge being at about 6,650 feet elevation. For purposes of description they are referred to point A, which is directly above Station No. 2 in the drift below. In this outcrop section, which follows a bearing of about north 7 degrees west, the showings examined are along the eastern side of a basic dyke from 8 to 10 feet wide, dips being westerly at angles of from 65 to 85 degrees or in some cases vertical. The dyke cuts brown-weathering soft rock, probably altered serpentine, which is traversed, in places, by numerous veinlets of chalcedony. Chaining southerly from point A an open-cut, at 20 feet, exposes the following section: Against the dyke, 5 inches of oxidized decomposed material containing sulphide remnants; a 29-inch central parting of weathered silicified rock; and next to it a 6-inch oxidized decomposed streak. From 20 to 84 feet there is overburden or shattered rock. At the latter point there is an outcrop of sheared, oxidized, silicified rock, showing some green stain. At 96 feet there is a 40-inch width of silicified rock containing heavily oxidized streaks with sulphide remnants, chiefly sphalerite. From 96 to 133.5 the vein has been traced and partially stripped where it consists chiefly of sheared silicified rock with oxidized streaks in places. At the latter point an open-cut exposes a 56-inch width of oxidized green-stained material containing masses and bands of sulphides, in which sphalerite and pyrite predominate. A sample across 56 inches assayed: Gold, 0.12 oz. per ton; silver, 3 oz. per ton; zinc, 10.1 per cent. At 145.5 feet an open-cut exposes a 62-inch width of dark rusty rock containing heavily oxidized streaks. At 161.5 feet an open-cut shows an 8-inch width of oxidized decomposed material, the adjoining rock on the eastern side being silicified and iron-stained in part. From 161.5 to 179.5 feet the outcrop is covered by slide-rock. At the latter point an open-cut exposes a 40-inch width of sheared rock, including an oxidized streak on the western side and a 15-inch oxidized decomposed band on the eastern side. The outcrop is covered from 179.5 to 197.5 feet. At the latter point an open-cut shows a 3-foot width of sulphide masses and oxidized iron-stained material. A sample across 3 feet assayed: Gold, 1.02 oz. per ton; silver, 6 oz. per ton; zinc, 18.3 per cent. At 233.5 feet an open-cut exposes a 6-foot width of oxidized, black to brown, decomposed material with some included silicified rock containing sulphide-streaks. At 253 feet, the intervening ground being covered, an open-cut exposes shearing with from 3 to 4 feet of underlying iron-stained rock, no definite mineralization being in evidence.

Another section of vein-outcrop, possibly the faulted southerly continuation of the previously described showings, is exposed in bluffs at 6,600 to 6,610 feet elevation on the western and south-western slope of the ridge just below its apex. This section, 70 feet long and from 6 to 10 inches wide, has about the same strike and lies 110 to 120 feet to the west, its northern end being opposite a point 190 feet southerly from point A. At its southern extremity the showing splits into stringers and at the northern end it curves north-easterly and is then dragged south-easterly along an apparent fault striking towards the first described vein section. Just south of the fault a hornblende-porphyry dyke, 3 to 4 feet wide, causes minor

displacement. The vein consists of banded sulphides and decomposed streaks between smooth, approximately vertical walls. A sample across 10 inches assayed: Gold, 1.04 oz. per ton; silver, 2 oz. per ton. Northerly from point A the dyke, about 5 feet wide, with no accompanying mineralization, can be traced for about 100 feet or to a point above Station No. 1 in the drift below. In about the centre of this section, the dyke, looking northerly, is displaced about 9 feet to the east on a south-easterly-striking fault.

The portal of the adit, at 6,275 feet elevation, is 422 feet on a bearing of north 32 degrees 35 minutes east from point A. This working is first driven as a crosscut south 43 degrees 40 minutes west for 390 feet. At Station No. 1, 368 feet in from the portal, drifts extend northerly and southerly. The north drift, extending north 21 degrees west for 66 feet, contains a winze 11 feet deep, between points 25 and 35 feet from Station No. 1. The south drift has been driven south 13 degrees east for 99 feet to Station No. 2, then south 18 degrees 45 minutes east for 84 feet to Station No. 3, and finally south 34 degrees 20 minutes east for 20 feet to Station No. 4, where a fault cuts off the dyke and shearing and a crosscut extended south 50 degrees west for 37.5 feet. (This face was being advanced.) Beyond Station No. 4 the main working continues south 45 degrees east for 17 feet to the face. Other workings consist of a curving branch driven 25 feet southerly from Station No. 2 and a branch 6 feet long east of Station No. 3. In the drift sections the dyke is from 4 to 5 feet wide, its western wall being generally well marked with gouge and evidence of shearing. The eastern wall is poorly defined in general. Dips at underground points approximate the vertical with a tendency to dip westerly. In the north drift between Station No. 1 and the winze, 25 feet northerly, mineralization is present on both sides of the dyke, the two narrow pay-streaks joining and forming a short lens across the full width of the drift at a point 2 feet southerly from the winze. In the roof, 10 feet above the drift-floor and directly above the winze, the vein along the western wall is 3 feet wide and largely decomposed, some sphalerite-streaks being present. Northerly from the winze the western pay-streak, averaging 4 inches wide, extends for 16 feet. The dyke comes to a point, terminating here, and beyond to the face, which is in schistose greenstone, the sheared western fracture continues without any mineralization. Along the eastern wall, between chainage-points 8 and 10 feet northerly from the winze, there is a 2-foot length of mixed sulphide mineralization 3 inches wide. The following samples, taken along the continuous western pay-streak section, 45 feet in length, are referred to chainage-points northerly from Station No. 1: (1.) Across 6 to 8 inches at 10 feet: Gold, 0.26 oz. per ton; silver, 1 oz. per ton. (2.) Across 10 inches at 15.5 feet: Gold, 0.40 oz. per ton; silver, 0.6 oz. per ton. (3.) Across 64 inches at 23 feet: Gold, 0.74 oz. per ton; silver, 2.8 oz. per ton; zinc, 4.7 per cent.; arsenic, 1.15 per cent.; antimony, 4 per cent. (4.) Across 3 feet at 30 feet: Gold, 0.56 oz. per ton; silver, 0.8 oz. per ton. (5.) Across average width of 4 inches representing 16-foot length between 35 and 51 feet: Gold, 0.60 oz. per ton; silver, 2 oz. per ton. A sample across 10 inches representing a 2-foot lens on the eastern wall, between chainages 43 and 45 feet northerly from Station No. 1, assayed: Gold, 0.40 oz. per ton; silver, 0.6 oz. per ton. A sample representing a narrow lens, swelling up to 24 inches, along the eastern wall between chainages 10.5 feet northerly and 3.5 feet southerly from Station No. 1, extending across the drift-crosscut intersection, assayed: Gold, 1.30 oz. per ton; silver, 1.2. At its northern end this showing pinches and then reappears just south of the winze, where it is included in the 64-inch width sampled at the junction of the two pay-streaks. In the 11-foot winze, where mineralization is irregular, the two pay-streaks have joined and form a 7.5-foot width at from 7.5 to 8.5 feet down from the collar, just above the water-level. Samples across this 7.5-foot section on the northern and southern sides of the winze assayed respectively: Gold, 0.44 oz. per ton; silver, 3 oz. per ton; arsenic, 5.3 per cent.; and: Gold, 0.50 oz. per ton; silver 1 oz. per ton; zinc, 8.2 per cent.; arsenic, 0.65 per cent. On the southern side of the winze, 6 feet below the collar, the vein complex from west to east is as follows: (1) 6 inches of massive sulphides; (2) 49 inches of rock-parting; (3) 28 inches chiefly consisting of massive sulphides. The 6-inch section assayed: Gold, 0.20 oz. per ton; silver, 1 oz. per ton; arsenic, 9 per cent.; and the 28-inch section assayed: Gold, 0.7 oz. per ton; silver, 2.2 oz. per ton; arsenic, 8.7 per cent.

Chaining southerly from Station No. 1, mineralized sections along the western wall of the south drift are as follows: (1) 28-foot length, averaging 11 inches in width, between 8 and 36 feet, which assayed: Gold, 0.24 oz. per ton; silver, 0.1 oz. per ton; (2) 18-inch length, up to 4 inches wide, between 51 and 52.5 feet; (3) 16-foot length of irregular mineralization,

4 to 8 inches wide, between 59 and 75 feet. According to the company's assay-plan, values in the above Nos. 2 and 3 sections are low grade.

The most southerly mineralization encountered underground is a 14-foot length, up to 3 inches wide, between points 3.5 and 17.5 feet southerly from Station No. 2. The fault at Station No. 4, which cuts off the dyke and shearing, strikes about south 7 degrees 30 minutes west and dips westerly at 36 degrees. The crosscut driven south-westerly from Station No. 4 starts beyond or under the fault, but cuts through it, returning to its upper or western side. The face of the crosscut had just broken into a silicified and slightly carbonatized feldspar-porphyry dyke with a northerly strike and 65-degree easterly dip. The most southerly face of the main workings, beyond the fault, was in silicified argillite.

New work done included ground-sluicing at a point known as 36-X, which is on the *Homestake No. 3* claim, 3,600 feet from the *Lucky Strike* workings, or 2,200 feet north-easterly from the camp. Extensive ground-sluicing, now largely caved, has been done in deep overburden at the toe of the slope on the north-western side of the Taylor Creek Valley, adjoining a small creek. In this vicinity there are numerous small masses, up to 1 foot in diameter, of float consisting of sphalerite, pyrite, stibnite, and arsenopyrite, in a gangue of quartz and calcite. A grab sample assayed: Gold, 0.30 oz. per ton; silver, 2.4 oz. per ton. In the ground-sluiced area, and for several hundred feet along the creek, there is much blue clay, in compact masses, which contains rusty streaks with disseminated sulphide specks including pyrite and arsenopyrite. A grab sample of this material assayed: Gold, 0.12 oz. per ton; silver, 0.6 oz. per ton. The float and clay appear to be derived from a decomposed outcrop in this vicinity.

C. D. Salkeld, manager, reports that a compressor plant was installed in December, 1936. The equipment includes a Gardner-Denver compressor rated at 115 c.f.m. and a 33-horse-power Diesel caterpillar engine. Recently it has been announced that the Lucky Strike Gold Mining Company has been incorporatetd in connection with the property.

Roxey Creek.

Gun Creek Area.

Gem.

This group, in the Lillooet Mining Division, consists of eleven mineral claims and fractions held by location and owned by W. Haylmore. The property is situated on the eastern side of Roxey Creek, a north-easterly-flowing tributary of Gun Creek, the approximate latitude and longitude being 50 degrees 52 minutes and 123 degrees 01 minute respectively. The workings, at elevations of from 6,420 to 6,480 feet, are on the very steep to precipitous, rocky, open ground sloping westerly from the top of the ridge at 6,860 feet elevation to about 6,000 feet elevation, where slopes flatten to the creek at approximately 5,400 feet elevation. The lower slopes are wooded, vegetation at higher levels being limited to scattered clumps of small evergreens.

Access to the camp-site, at 6,100 feet elevation, is by pack-trail 6 miles in length, roughly estimated, from the road at the *Pilot* mine, situated towards the centre of the western side of Gun Lake. This branch road, 7 miles in length, connects with the highway near the junction of the Bridge and Hurley Rivers, 40 miles from Bridge River Station on the Pacific Great Eastern Railway. Another pack-trail, possible 7 miles in length, used to reach the *Gem* and other prospects in the adjoining district, leaves the highway near the *Wayside* mine and extends north-westerly around the head of Gun Lake and eventually connects with the trail from the *Pilot* mine.

The formation is composed of quartz diorite of the Bendor batholith, the local phase being a biotite quartz diorite, a medium-grained light-greenish rock highly altered in the vicinity of the deposits. Parallel to the main showing, and 25 feet to the east of it, a brown-weathering dyke of ferruginous carbonate composition cuts the batholithic rock along an easterly strike with a vertical dip.

The work done, consisting of open-cuts and stripping, is localized in the vicinity of two lenticular mineralized bodies located *en échelon* along an easterly-westerly trend. The larger showing is associated with an easterly-striking fracture which was traced for a length of 45 feet, conditions at both extremities being obscure. The deposits consist of massive to finely crystalline arsenopyrite, which shows incipient oxidation along some of the fractures, in streaks, masses, and disseminations in the irregularly silicified igneous rock. Quartz is occasionally present, and cobalt-bloom is comparatively well developed in places. The arsenopyrite,

generally uniformly distributed throughout the gangue, also occurs in exceptionally large masses, as, for instance, a sample across 5.5 feet which assayed: Gold, 1.32 oz. per ton; silver, trace; arsenic, 44.2 per cent. Selected material with a little included quartz assayed: Gold, 1.24 oz. per ton; silver, 0.20 oz. per ton.

In the most northerly or No. 1 showing, stripped for a length of 45 feet between elevations of 6,440 and 6,480 feet, the width of the mineralization is only partially exposed in most places. Commencing at the top and chaining westerly down the steep to precipitous slope, widths of arsenopyrite mineralization are as follows: At zero, elevation 6,480 feet, 4.5 feet; at chainage 4 feet, 10.5 feet, which assayed: Gold, 0.56 oz. per ton; silver, 0.1 oz. per ton. At chainage 14 feet, 2.5 feet, which assayed: Gold, 0.42 oz. per ton; silver, 0.2 oz. per ton. At chainage 28 feet, 2.5 feet, which assayed; Gold, 0.32 oz. per ton; silver, trace; the adjoining 2-foot width to the north being more lightly mineralized with arsenopyrite. At chainage 36 feet, 1.5 feet; and at chainage 45 feet, 8 inches of oxidized material containing specks of arsenopyrite and spots of cobalt-bloom. Below the latter point the fracture could not be traced where the ground falls abruptly. To the west going towards Roxey Creek the rocks are iron-stained in places along the general trend of the deposit.

The No. 2 lens, the eastern or upper end of which is 17 feet southerly from chainage 42 feet on No. 1 lens, has been stripped for a length of 24 feet between elevations of 6,435 and 6,450 feet. No definite fracturing was observed in the case of this showing, which is heavily mineralized with arsenopyrite throughout its length, widths varying from 5 or 5.5 feet at the extremities to 1.5 feet where it narrows locally between points 7 and 10 feet from the lower end. No continuity was apparent beyond the upper point and the ground immediately below was covered by talus. A sample across 5.5 feet at the lower extremity of the exposure assayed: Gold, 1.32 oz. per ton; silver, trace. Fifteen feet to the south-west there is an open-cut at 6,420 feet elevation, where arsenopyrite occurs in streaks and disseminations, with some quartz in the altered siliceous igneous rock, the mineralization being associated with a local fracture striking north 40 degrees east and dipping at 45 degrees to the south-east. A sample across the 2.5-foot section next to the hanging-wall assayed: Gold, 0.24 oz. per ton; silver, 0.2 oz. per ton; and a sample across the adjoining 3 feet on the foot-wall side assayed: Gold and silver, trace. Continuity is not apparent to the south-west, where the rock is largely decomposed, and to the north-east loose rock separates the small exposure from lens No. 2. Prospecting on the ground was carried on during the summer months.

Mainland Coast and Islands.

Loughborough Inlet Area.

Loughborough Gold Mines, Ltd.

This company's property, in the Vancouver Mining Division, consists of twelve mineral claims held by location. They are situated on the eastern side of Loughborough Inlet, about 139 miles in a direct line north-west of Vancouver. The camp, adjoining deep water, is 1.5 miles north of Roy Post-office and 1 mile south of Gray Creek. The claims cover ground sloping irregularly to the inlet on the west, the gentle to fairly steep slopes being interrupted by benches and depressions, or hills with abrupt to almost vertical faces on their western sides. The various workings are at elevations of from a little above sea-level to 900 feet, the upper of two closely spaced adits on the *Loughborough* claim, being driven into the base of a vertical bluff, at 570 feet elevation, above a swampy bench. The area is densely wooded and near Gray Creek there are patches of big timber, the trees, up to 5 feet in diameter, including hemlock, cedar, and Douglas fir. Water is plentiful on the claims and conveniently accessible for general purposes. A small creek, situated about 1,200 feet southerly from the main workings, has a fall of 300 feet in a comparatively short distance, affording potentialities for a useful water-power development at moderate cost. The property is well situated for cheap transportation, a weekly passenger and freight service being maintained by the Union Steamship Company to Roy Wharf. Heavy freight, including sacked ore shipments, have been handled at the landing near the camp-site, from which a tractor-road 1.3 miles in length leads easterly to the mine.

The predominating formation consists of hornblende diorite of the Coast Range batholith. Locally this rock has a medium to coarse-grained texture, being composed essentially of altered andesine with a few grains of interstitial quartz and abundant fresh hornblende. Chlorite, epidote, calcite, and kaolin are common and some relatively large apatite aggregates are present.

The rock is traversed in places by veinlets containing epidote and sanidine. Complexly associated with the hornblende diorite are dykes and intrusive bodies of highly-altered, acidic character, two specimens of which were determined as follows: (1.) Light-coloured phanerocrystalline rock, which, under the microscope, shows abundant quartz (30 to 40 per cent.) occurring as anhedral grains in a complex of shreddy white mica, kaolin, and calcite, with a few unaltered fragments of feldspar, " ghosts " of old feldspars being outlined by the complex. A little hornblende, largely gone over to chlorite, with epidote, chlorite, and iron ore, are present, apatite occurring as an accessory mineral. (2.) Light-coloured, medium- to fine-grained equigranular rock composed of equal amounts of quartz and feldspar, the latter mineral being highly altered and in places showing fine twinning, probably both orthoclase and albite or albite-oligoclase. The rock contains a little disseminated chlorite, epidote, and iron ore.

The principal veins follow fractures or narrow shear-zones having a general north-easterly strike with steep south-easterly dips. They generally occur along the irregular contact of the hornblende diorite and the acidic intrusives, but in places penetrate the latter, which are sometimes silicified and pyritized. Mineralization consists of disseminated grains and crystalline aggregates of pyrite irregularly distributed through the gangue of quartz and altered, sheared, frequently silicified rock. No other minerals were noted, but small percentages of copper are present in some shipments listed below. Values are principally in gold with accessory silver. In one polished section, examined under the microscope, no gold was seen with magnifications up to 450 diameters. Crushing of similar material to 200 mesh should release almost all the sulphide from the gangue. The following shipments of sorted ore, made to the Tacoma smelter in 1935 and 1936, total 110 tons, averaging 0.9 oz. gold per ton and 3.5 silver per ton:—

Date shipped.	Dry Weight.	Gold.	Silver.	Copper.
	Tons.	Oz. per Ton.	Oz. per Ton.	Per Cent.
July, 1935	48.8885	1.10	4.37	.....
Dec., 1935	12.0705	0.64	2.38	0.19
Sept., 1936	41.1070	0.55	2.40	0.10
Sept., 1936	8.0465	1.88	7.17	0.08

The property, first known as the *Golden Gate* group, was staked in 1933 by W. Willis, being acquired in 1935 by the Loughborough Gold Mines, Limited, a private company. In September, 1936, the present public company was incorporated.

On the *Loughborough* claim, adit-workings, at elevations between 530 and 570 feet, develop two closely-spaced veins which appear to join going north-easterly. They strike about north 75 degrees east and have south-easterly dips of from 65 to 80 degrees. On the surface they outcrop on a bluff at, and to a height of about 35 feet above, the portal of the upper adit. The possible south-westerly extension of the outcrop is covered in the swampy flat ground below the adits. Going north-easterly for 125 feet up the steep ground beyond the top of the cliff, a small stripped patch, at 660 feet elevation, exposes a width of 20 inches of iron-stained hornblende diorite and quartz containing light pyrite mineralization and some oxidized streaks. A sample across the width specified assayed: Gold, 0.12 oz. per ton; silver, 0.1 oz. per ton. At from 850 to 900 feet elevation and 725 feet to 755 feet north-easterly from the upper adit-portal, two small cuts show quartz, 1 to 3 feet wide, in granitic rock along a fracture striking north 75 degrees east and dipping 65 degrees to the south-east. In both cuts minor amounts of scattered pyrite are present in the quartz. These showings are along the trend of the main vein in the upper adit and have similar dips, but surface-trenching at shorter intervals would be necessary to definitely correlate them. Hornblende diorite is exposed at and adjacent to the portal of the upper adit, at 570 feet elevation, but the workings on this level are chiefly in one or other type of the altered acidic intrusives. Measuring from the portal, or point A, it is driven as follows: East for 18 feet to B; north 81 degrees east for 16.7 feet to C; north 65 degrees east for 13 feet to D; and south 80 degrees east for 12.5 feet to the face at E. An offset is made from D for 5 feet north 22 degrees west to F, from which point a stope extended north 77 degrees east for 26 feet and south 77 degrees west for 18 feet. At the north-easterly and south-westerly ends the back of the stope was 35 and 20 feet respectively above the level, the stope-floors sloping down towards Station F. Since the writer's examination in June, 1936,

this stope is reported to have been enlarged and extended towards the adit-portal. From the latter point, or A, to 8 feet east the drift passes over the top of a raise, inclined to the east, which connects with the stope extension below the floor of the level. For the next 10 feet to B the drift passes over a pillar, and from B to 6 feet east over the top of a shaft sunk on the steep southerly dip of the vein and connecting with the lower adit 40 feet below. The northern vein, following the main fracture, was first exposed on the north side of the drift where side-swiping had been done 3 feet east of B. It is well defined, striking north 75 degrees east, with a south-easterly dip of 80 degrees. The same showing, sampled where it went into the north wall of the drift opposite the east side of the shaft, 6 feet beyond B, gave an assay, across 3 feet, of: Gold, 0.78 oz. per ton; silver, 4 oz. per ton. Next to this sample section, going south across the roof of the drift, there was 22 inches of silicified rock, then 4.6 feet of scattered pyrite in a siliceous gangue which assayed: Gold, 0.1 oz. per ton; silver, 0.1 oz. per ton. This last section is associated with the subsidiary southern fracture which is fairly well defined over the shaft, but becomes irregular and curves north-easterly going towards the stope. East of the shaft conditions are indefinite, and pyrite is of sparse occurrence in scattered quartz and silicified rock over narrow widths chiefly along the northern wall of the drift. The stope is along the north-easterly extension of the northern vein as sampled previously in the drift, but both veins have been stoped together in places. The northern vein is well marked with a smooth foot-wall dipping from 65 to 75 degrees to the south-east, its width averaging about 2 feet. Some quartz-pyrite mineralization was visible along the greater part of the back of the stope, which was about 20 feet, roughly estimated, below the surface. The following three samples, representing one section from foot-wall to hanging-wall, were taken at the upper north-easterly end of the stope: (1) 22 inches assaying: Gold, 0.22 oz. per ton; silver, 1.2 oz. per ton; (2) 26 inches of rock-parting assaying: Gold, 0.03 oz. per ton; silver, trace; (3) 22 inches assaying: Gold, 0.54 oz. per ton; silver, 2 oz. per ton. A sample across 32 inches in the face at the upper south-westerly end of the stope assayed: Gold, 0.62 oz. per ton; silver, 2.2 oz. per ton; and a sample across 5 feet in the roof, 4 feet back from the last sample location, assayed: Gold, 0.26 oz. per ton; silver, 1.2 oz. per ton.

The lower adit-portal, or point G, is 70 feet west of point A and at 530 feet elevation. It is driven as follows: South 65 degrees east for 53 feet to H; north 65 degrees east for 19 feet to J; east for 51 feet to K; south 80 degrees east for 46 feet to L; north 55 degrees east for 12.5 feet to M; and north 10 degrees west for 36 feet to the face at N. There is a crosscut, 6.5 feet west of K, which extends north 2 degrees east for 12.5 feet. Connection is made with the shaft (east of B in the upper level) at points 23 to 29 feet east of J. This shaft is said to continue down on the same steep incline for 40 feet below, but is inaccessible, being largely filled in. A sample across 2 feet 20 feet easterly from the shaft at a point midway between the two levels, where stoping on the northern vein was proceeding, assayed: Gold, 0.46 oz. per ton; silver, 2.4 oz. per ton; and a sample across 28 inches, just west of the shaft at the same intermediate level, assayed: Gold, 0.22 oz. per ton; silver, 0.8 oz. per ton. The first course of the lower adit, from G to H, passes through talus and is close-timbered. In the drift section, beyond this crosscut approach, the veins follow the irregular contact-zone of the hornblende diorite and altered intrusives, the former rock lying to the north of the vein system. The northern vein is first encountered at H, where it is from 20 to 32 inches wide and apparently low grade as exposed in the roof on the northern side of the drift. Continuing easterly, this vein, swelling and pinching with average narrow width, is followed by showings in the floor to K, a section 20 feet long adjoining the shaft having been stoped. At K an 8- to 10-inch vein comes into the south wall from the hanging-wall side, where a sample across 8 inches assayed: Gold, 0.26 oz. per ton; silver, 0.15 oz. per ton. At a point 11 feet easterly from K the two veins have joined and form one vein, which is followed to within 10 feet of L, where it breaks up into several narrow stringers. In the face at L there is no definite fracture, slip-planes tending to strike easterly, with southerly dips of 70 degrees to 80 degrees. A sample across 30 inches in the floor of the drift, 16.5 feet easterly from K, assayed: Gold, 0.26 oz. per ton; silver, 3.6 oz. per ton; and a sample across 9 inches, 10 feet westerly from L, assayed: Gold, 0.34 oz. per ton; silver, 0.05 oz. per ton. Between L and M the working is largely in altered rock and from M to N in hornblende diorite. Opposite M a branch has been driven easterly for 4 feet along a narrow aplite dyke contained within a zone of altered, silicified, crushed rock bordered by fracture-planes striking south 65 degrees east and dipping steeply to the south-west. The short crosscut west of K is in hornblende diorite. The combined dumps of the two

adits are estimated to contain about 700 tons of mineralized quartz and vein material which is lower grade than the ore shipped but of potential contributory value if future development warrants mill-installation. A grab sample from these dumps, not representative of bulk, assayed: Gold, 0.36 oz. per ton; silver, 1.2 oz. per ton. The outcrop of the above vein system can be explored for new ore-shoots by surface work. Lateral extensions to the partly-exploited shoot may be found by further drifting and its downward extension can be tested by cleaning out the shaft and continuing work at a lower horizon, if found warranted by conditions.

South-east of the adit-workings a quartz vein has been exposed by open-cuts and stripping over a length of 50 feet at 865 feet elevation. It strikes north 75 degrees east and dips south-easterly at 65 degrees and, with silicified rock inclusions, is from 2 to 8 feet wide, containing finely disseminated pyrite in places.

On the *Stuart* claim, about 3,000 feet north-north-west of the above-described main workings, a limited amount of exploratory work has been done, at 280 feet elevation, on timbered ground sloping gently towards the inlet. A small quartz-outcrop is exposed at the top of a 20-degree inclined shaft which is said to be from 15 to 20 feet deep. It was nearly full of water, so that the character and attitude of the vein were difficult to determine. It appears to strike easterly with a southerly dip approximating 30 degrees and, at the collar of the incline, consists of a width of 1.5 feet of quartz containing scattered small masses and disseminations of pyrite. Adjoining this showing, the intrusive igneous rock is highly altered and silicified. A selected sample of massive pyrite, with a little quartz, assayed: Gold, 0.24 oz. per ton; silver, trace. At 255 feet elevation, and 86 feet south-easterly from the incline, there is a 26-foot adit, driven along a curving south-westerly course, which has not reached its objective. More trenching would be necessary to determine the true strike and attitude of the vein at the incline from which good assays are said to have been obtained.

At 260 feet elevation, about 400 feet north-easterly from the incline and beyond a small creek, there is an 8-foot adit leading to a 9-foot winze full of water. These workings expose irregular, sparsely-mineralized quartz-bands and stringers lacking specific definition. Selected quartz and pyrite from this point assayed: Gold, 0.02 oz. per ton; silver, trace.

Near the shore on the *Leora* claim, about 1,500 feet west of the *Stuart* incline, there is a 10-foot adit cutting a vein, 6 to 12 inches wide, which strikes north-easterly with a steep south-easterly dip, no definite mineralization being present at the point exposed.

Intensive prospecting of the property should disclose extensions of present veins and other veins, the surface being largely covered with brush, moss, and soil which conceal most outcrops.

Adjacent to the freight platform and float, camp buildings on the *Gordon* claim include bunk- and cook-house accommodation for about twelve men, change-room, and office. At the mine a Gardner-Denver compressor, of about 125 c.f.m. capacity, is driven by a Leland 65-horse-power gas-engine. A Massey-Harris 50-horse-power tractor and trailer were in use for hauling sacked ore to the landing.

East Thurlow Island Area.

Thurlow Gold Mines, Ltd.

The property of this company, in the Vancouver Mining Division, consists of sixteen mineral claims held by location. Since 1934 work has been carried on intermittently under lease by the Northern Mining and Milling Company. The claims are on the easterly side of East Thurlow Island contiguous to Nodales Channel, about 127 miles in a direct line north-westerly from Vancouver. The general topography of the island is of rugged character, the summits of the wooded hills being at elevations of from 1,400 to 2,203 feet above sea-level. The vegetation is dense, which, taken into consideration with the generally deep overburden, impedes prospecting. The adit, at 200 feet elevation, is at the foot of the steep to precipitous ground sloping south-easterly to a bench, at from 170 to 185 feet elevation, on which the shaft-site and camp buildings are situated, the workings being within 1,800 feet of the beach. Deep water extends close to the shore, the float, at which freight is handled, being about 5.25 miles easterly by water around the north-eastern end of the island from Thurlow (Shoal Bay), the nearest settlement. Transportation to Thurlow and local points is provided by Union Steamship Company boats. From the landing a tractor-road, over which a truck has been driven, extends for 2,000 feet to the main workings.

The formation is chiefly composed of granodiorite of the Coast Range batholith, which, adjacent to the developed section of the vein, contains numerous scattered inclusions of andesite. The vein, generally varying in width from 3 to 7 feet, strikes north-westerly and dips south-westerly at angles of from 50 to 70 degrees. It is somewhat irregular in strike and dip and is broken at several points by pronounced faults. At points in the main adit-drift the vein contains flat-lying "horses" of granodiorite 2 to 4 feet thick.

Mineralization consists of pyrite, with occasional chalcopyrite, the sulphides being irregularly distributed as disseminations, streaks, or masses through the quartz gangue. The following assays indicate the value in specimen and selected material: (1.) Massive pyrite: Gold, 5.54 oz. per ton; silver, 4.4 oz. per ton. (2.) Mixed chalcopyrite and pyrite with a little quartz: Gold, 1.14 oz. per ton; silver, 7.2 oz. per ton; copper, 6.5 per cent. (3.) Quartz, lacking visible sulphides: Gold, 0.08 oz. per ton; silver, 0.2 oz. per ton. (4.) Mill concentrate: Gold, 1.64 oz. per ton; silver, 0.6 oz. per ton; copper, 1 per cent.

The history of the property, as recorded in the Annual Reports of the Minister of Mines for 1919, 1927, 1928, 1930, and 1933, and in Bulletin No. 1, 1932, "Lode-gold Deposits of British Columbia," is summarized as follows: The nucleus of the present property, first known as the *Dawn* group, was staked by A. Pritchard. Development-work was initiated by the Ladysmith Smelting Corporation in 1919. It was renamed *Hope* group in 1927. The Thurlow Gold Mines, Limited, was incorporated in 1928, and in 1931 the Pacific Copper Mines, Limited, acquired an option and continued development. In 1933 the property was under option to the Federal Gold Mines, Limited, and since 1934 it has been worked at intervals by R. W. Burton, H. W. Dewhurst, and associates of the Northern Mining and Milling Company. They installed a mill of a nominal capacity of 10 tons in 24 hours at the portal of the adit at 200 feet elevation. The equipment includes a 5- by 7-inch "Universal" jaw-crusher, a 36- by 30-inch Union Iron Works ball-mill, plunger-type Vancouver Engineering Works feeder, and Wilfley concentrating-table, the machinery being driven by Fairbanks-Morse 12-horse-power oil-engine. Small lots of concentrates and sorted ore were shipped to the Tacoma smelter at intervals during 1935 and 1936.

Going south-easterly from the highest point, the workings are located as follows: Connected open-cuts along a line of low bluffs between 355 and 345 feet elevation; portal of adit, 60 feet south 30 degrees east from the lowest surface showing and at 200 feet elevation; open-cut (south-eastern end) 177 feet south 23 degrees east from the adit-portal and at 190 feet elevation; collar of inclined shaft 212 feet south 23 degrees east from the adit-portal and at 185 feet elevation. The first-mentioned open-cuts expose an outcrop-length of 37 feet along an irregular northerly strike with a westerly dip of 50 degrees, the vein being cut off at its southern end by a fault striking north 83 degrees east and dipping northerly at 72 degrees. At the northern end conditions are indefinite, the vein pinching, possibly approaching another fault not exposed. With the exception of the 8-foot northerly section, which is slightly displaced on a minor fault, the showing is continuous, widths being from 46 to 64 inches. A sample taken across 48 inches on the foot-wall side of the vein at the southern end of the exposure, next to the fault, assayed: Gold, 0.32 oz. per ton; silver, 0.5 oz. per ton; and a sample across the adjoining 16 inches on the hanging-wall side assayed: Gold, 0.03 oz. per ton; silver, 0.2 oz. per ton. A sample across 46 inches, 17 feet northerly from the southern end, assayed: Gold, 0.08 oz. per ton; silver, 0.3 oz. per ton.

The adit is driven north 20 degrees west for 136 feet, conditions being described by measurements from the portal. At 92 feet a branch extends north 70 degrees west for 34 feet, and at 102 feet another branch extends first north 50 degrees for 33.5 feet, then north 30 degrees east for 21.5 feet. Between points 82 and 90 feet there is a winze, about 15 feet deep, sunk on the vein, dipping 60 to 65 degrees westerly. Above the level the vein has been stoped to the surface over a width of from 7 to 8 feet between points 11 and 32 feet in from the portal, the foot-wall dip here being 65 degrees south-westerly. In this section, at chainage 20 feet, the vein was displaced 2.5 feet south-westerly on a fault striking north 70 degrees east and dipping from 75 to 80 degrees southerly. This vein does not persist in the back of the stoped section, 27 to 13 feet above the level, between chainages 32 and 67 feet, its crest plunging north-westerly down to the winze location, where it is 2.5 feet below the adit-floor. No definite break or fault was noted to account for this condition. Just beyond chainage 32 feet there is a short length of pyritized quartz, 12 to 18 inches wide, associated with poorly-

defined fracture-planes dipping 50 degrees easterly, the quartz appearing to continue up on this dip towards the surface. The easterly-striking fault noted on the surface, at 245 feet elevation, was not definitely located in the drift, but its projected position at the latter horizon corresponds closely to the end of the stoped section at chainage 67 feet. In the main adit at chainage 116 feet, and crossing its two branches, there is a pronounced fault striking about north 81 degrees east and dipping 76 degrees northerly, this being beyond the vein-exposures.

The vein, showing in places in the floor of the adit, between the portal and chainage 92 feet, is not properly exposed for sampling at regular intervals. Samples taken at accessible points gave the following results: Across 4 feet of massive pyrite mineralization at 92 feet, or 2 feet northerly from the winze-collar, 2.5 feet below the floor-level: Gold, 4 oz. per ton; silver, 2.8 oz. per ton. Across 6 feet, 12 feet down the winze and just above water-level: Gold, 0.26 oz. per ton; silver, 0.15 oz. per ton. Across 2.5-foot partial exposure at 73 feet: Gold, 1.24 oz. per ton; silver, 2 oz. per ton. Across 2-foot partial exposure at 34 feet: Gold, 0.12 oz. per ton; silver, 0.4 oz. per ton. Across 3.5-foot partial exposure at 32 feet: Gold, 0.30 oz. per ton; silver, 0.5 oz. per ton. The vein in the floor is evidently continuous and irregularly mineralized throughout the section specified, or for a length of 92 feet, with concentrations of pyrite adjacent to the winze. It will be noted that the 50-degree westerly dipping, 37-foot outcrop section, lies a little to the west of and opposite the adit vein section in the floor between points 66 and 103 feet in from the portal. This roughly corresponds to the missing top portion of the vein over its plunging crest. The relationship of the two vein sections is not known, but they could be connected with a small amount of work from the level. This might disclose information having a bearing on the continuity of the vein to the north. Extension of the north-westerly branch for a short distance should encounter the surface showing on its dip, unless it has been disturbed by faulting before reaching the level. The open-cut, 177 feet south-easterly from the adit-portal, is from 15 to 20 feet long but largely caved. Pyritized and iron-stained quartz up to 22 inches wide is visible in the floor for a length of 12 feet at the south-westerly end of this working, which extends along a bearing north 35 degrees west. The 2-compartment inclined shaft, full of water to within 6 feet of the collar, was sunk westerly about 65 degrees. An authoritative plan shows it to be 72 feet deep, with a drift at 120 feet elevation extending along a crooked north-westerly course for 80 feet to where the vein was cut off by a fault striking north 35 degrees east and dipping 35 degrees south-easterly. Beyond the fault a crosscut 20 feet long is shown extending northerly. This fault, projected to the surface, would pass a short distance in front of the portal of the adit. From the relative position of the two vein sections and assuming a dip of 65 degrees, a crosscut driven approximately 40 feet south-westerly from a point beyond the fault in the lower level should cut the extension of the vein developed by the adit. There is a considerable amount of quartz on the shaft-dump from which a small tonnage is said to have been sorted for milling or shipping. A grab sample, not necessarily representative of the remaining material, assayed: Gold, 0.10 oz. per ton; silver, 0.4 oz. per ton.

On the gentle slope adjoining the shore, between points about 1,200 and 1,400 feet south-easterly from the shaft-collar, an outcrop has been traced by trenching and stripping for a length of 200 feet. The showings here, which are along the general trend of the previously described vein section, are associated with well-defined fracture-planes striking from north 45 degrees west to north 50 degrees west and dipping 80 degrees south-westerly or vertical. Pyrite mineralization in this section is generally light, with occasional massive streaks. Widths are from 15 inches at the shore to 18 inches at the northern end, the maximum width noted being 28 inches, where a sample assayed: Gold, 0.10 oz. per ton; silver, trace. Accommodation for a small crew is provided by buildings near the mine and there is a manager's residence at the landing.

Phillips Arm Area.

Doratha Morton. This property, in the Vancouver Mining Division, consists of the following nine Crown-granted mineral claims and fractions: *Doratha Morton*, *Doratha Morton Fr.*, *Percy*, *Africa*, *Comox Fr.*, *Chimnang*, *Eva*, *Douglas*, and *Banker*, said to be held under working agreement by interests locally represented by R. Crowe-Swords, of the Hercules Consolidated Mining, Smelting, and Power Corporation. This company is said to hold forty-eight adjacent claims by location, these being recent stakings. The precise location of the Crown-granted claims is shown on B.C. Department of Lands Mineral Reference

Map No. 5T280. The holdings extend westerly from the western shore of Phillips Arm, covering an area immediately south-west of Fanny Bay, the beach camp being approximately 135 miles in a direct line north-westerly from Vancouver. The mine camp, adjoining the principal workings on the *Doratha Morton* claim, is on a bench at 2,300 feet elevation, which interrupts the general, steep, north-easterly slope to Phillips Arm. The area is well timbered with hemlock, cedar, and yellow cedar, with some fir at lower altitudes. Deep water extends close to the shore, the upper camp being connected with the landing by a steep, wide trail.

The deposits occur in a shear-zone, up to 100 feet or more in width, striking north-westerly and dipping south-westerly at angles of from 70 to 80 degrees. In a general way it follows the irregular contact between argillaceous, schistose rocks, and granitic rocks of the Coast Range batholith, but, in detail, cuts both formations in places. The igneous intrusives are of two distinct types, the deposits, which consist of numerous bands, stringers, and lenses of quartz, being found mostly in a medium- to coarse-grained, light-coloured, altered granite. The other type is a medium-grained, dark-coloured diorite or quartz diorite, a specimen of which, examined microscopically, was composed of abundant basic andesine, quite fresh but fractured and veined by epidote and hornblende, with a little orthoclase and microline, quartz being common, some of it undoubtedly secondary. Hornblende was abundant, commonly associated with iron ore, epidote, zoisite, and white mica. Some calcite was present in the rock, which was highly fractured, the fractures being filled with a complex of secondary minerals. The relative proportions of the principal minerals present were andesine, 50 per cent.; quartz, 15 per cent.; and hornblende, 25 per cent.

The formations and the deposits are cut by numerous irregular dykes and intrusive bodies of fine-grained andesitic rock which are later than the mineralization. The lenticular occurrences of quartz or silicified altered rock are irregularly mineralized with pyrite, which is generally in banded streaks or seams roughly parallel with the trend of the zone, concentrations being found where shearing has been intense. At a few points copper-carbonate stains accompany the pyrite, which occurs in massive form or as well-defined crystals. Gold values appear to be largely associated with pyrite, samples of selected material assaying from 1.10 to 2.34 oz. gold per ton and from 1.5 to 9.5 oz. silver per ton.

The history of the *Doratha Morton* group dates back to 1898 and 1899, this original operation having been closed down after about 10,000 tons of ore had been mined and treated in the cyanide-mill, situated at tide-water, which was connected with the mine-workings by an aerial tramway. Subsequently the machinery and mining equipment were removed and the property is reported to have remained idle until 1924, when some development was done by the Glasair Mining Company, of Vancouver.

Work was continued in 1933 and 1934 by the Hercules Consolidated Mining, Smelting, and Power Corporation, while the Santiago Mines, Limited, carried out a little work in 1935 under a lease agreement. No activity occurred at the property during 1936. References to the *Doratha Morton* are contained in the Annual Reports of the Minister of Mines for 1898, 1899, 1925, 1926, 1927, 1933, and 1934. In the last mentioned, page F 8, it is recorded that the production made in 1898 and 1899 yielded approximately 10,000 oz. silver and 4,434 oz. gold. The same report contains the assay results of numerous samples taken in the new and old workings. The latter, comprising five adits, include a total footage of about 2,100 feet of drifts and crosscuts, most of the stoping having been done above the No. 1 level, which develops the vein-zone for a length of 500 feet to a depth of from 10 to 150 feet. Work done on the *Doratha Morton* claim by the Hercules Consolidated Mining, Smelting, and Power Corporation consists of three adits, aggregating a total footage of about 250 feet, and a number of open-cuts. This later development, with which the present report is chiefly concerned, is located north-westerly from the old workings, the shear-zone now having been traced by openings, generally superficial, for a combined length of about 1,400 feet.

Conditions are described going south-easterly from the north-western extremity of the developed area. The rock formation is altered, frequently silicified, granite unless otherwise specified, and dykes are all of fine-grained andesitic type. In No. 2 open-cut, at 2,512 feet elevation, on the hanging-wall side of a narrow dyke, there is a 32-inch width of rusty quartz with pyrite-streaks, which assayed: Gold, 0.02 oz. per ton; silver, 0.1 oz. per ton. Eighty feet south-easterly the No. 1 open-cut, at 2,524 feet elevation, exposes a 17-inch width of similar quartz containing pyrite-specks, which assayed: Gold, 0.20 oz. per ton; silver, 1.0 oz.

per ton. This is on the hanging-wall side of a 42-inch width of interbanded quartz and rock, on the foot-wall side of which there are three short, narrow sections of dyke with varying westerly strikes and differing dips. The portal of the "250" level is at 2,455 feet elevation, and 90 feet north 40 degrees east from the No. 1 open-cut. Driven south 31 degrees west as a crosscut for 146 feet, it contains a drift, 55 feet in from the portal, which extends for 24 feet along the "foot-wall" fracture striking south 45 degrees east and dipping 80 degrees to the south-west. Chaining from the portal, this working intersects highly-metamorphosed, schistose, sedimentary rocks, including a narrow tongue of granite, to 47 feet; from 47 feet to 72 feet the rock is chiefly altered, silicified granite and quartz on the south-eastern side of the crosscut with fine-grained, somewhat altered, andesitic dyke on the opposite wall; this dyke then extends on both walls to a contact, striking easterly with 73 degree southerly dip, with altered silicified granite. The latter rock is then cut to 138 feet, where the "hanging-wall" fracture strikes south-easterly and dips 70 degrees south-westerly. Between this fracture and the face there is diorite, the composition of which was previously described. Samples, taken in the drift across 22 and 38 inches of iron-stained quartz at points 7 and 12 feet respectively from the crosscut, both assayed a trace in gold and silver per ton. In the face of the drift similar quartz is 1 foot wide and at the crosscut-drift intersection the showing is cut off by the irregularly-shaped large dyke previously mentioned. A sample across 20 inches of quartz and silicified granite at a point 12 feet back from the face of the crosscut, or at chainage 134 feet, assayed: Gold, 0.10 oz. per ton; silver, 0.5 oz. per ton. The portal of the "Old No. 2 workings" at 2,478 feet elevation is situated about 200 feet south-easterly from No. 1 open-cut. Superficial and shallow underhand stoping was done near the portal of this level, the main course of which extends westerly for about 145 feet. At 75 feet in from the portal there is a 15-foot north-westerly drift which develops a quartz-lens up to 33 inches wide. Its south-easterly end is cut off by a westerly-striking fault in the main adit and beyond this fault a southerly 12-foot branch opposite the drift is all in dyke. A recent extension consists of a 20-foot drift extending north-westerly from a point about 25 feet in from the portal, gaining shallow depth. This working developed a short section of high-grade ore which at its north-western extremity is cut off by a fault and at its south-eastern end merges with the old stope. A grab sample from a small pile of well-mineralized quartz assayed: Gold, 2.34 oz. per ton; silver, 6.5 oz. per ton. The small tonnages referred to in the Annual Report of the Minister of Mines for 1934 were shipped to the Tacoma smelter from this stope extension. In the main working the altered, silicified granite is exposed to a point 104 feet in from the portal, where there are spots of quartz adjoining a dyke which extends to the face.

The portal of the "100" level, at 2,480 feet elevation, is 260 feet easterly from the last-mentioned working. It is driven south 15 degrees east for 14 feet, then south 48 degrees east for 39 feet, the latter course being a drift. Immediately above the portal, to the south-east, there is a zone of alternating quartz bands and stringers, 8 feet wide, streaks of pyrite occurring along the hanging-wall side of the showing. No. 1 cut East, at 2,518 feet elevation, is about 40 feet south-easterly from the face of the "100" level. In this surface working there is exposed a 20-foot section which, from hanging-wall to foot-wall, is as follows: 11-inch quartz-lens; 11-inch diorite dyke; 12-inch quartz-band; 6 feet of diorite; 5 feet of sheared, altered sedimentary rock containing quartz stringers; 5-foot quartz-band. A sample across the last-mentioned section, which contained pyrite, assayed: Gold, 0.08 oz. per ton; silver, 0.4 oz. per ton. A selected sample from the same showing, which is 15 feet long and narrows to 20 inches at its north-western end, adjoining a slip, assayed: Gold, 1.10 oz. per ton; silver, 1.5 oz. per ton. Reverting to the "100" level, a sample across 12 inches from a quartz-showing partially exposed along the south-western wall of the drift between the face and a point 11 feet back assayed: Gold, 0.24 oz. per ton; silver, 0.7 oz. per ton. The north-western end of the No. 1 level drift of the old workings, which breaks through to the surface, is about 150 feet south-easterly from the No. 1 cut East and at 2,510 feet elevation. This drift, reached by a crosscut 103 feet long, is about 500 feet in length, developing the mineralized zone at depths of from 10 to 150 feet below the surface. Chaining south-easterly along the drift from the opening at the north-western end, stoping over an irregular area has been done above the level to 220 feet, where the mineralized granite host-rock is cut by diorite which intersects the drift to 265 feet. Silicified granite containing bands and patches of quartz is then followed

to 323 feet, in which section there is a small stope. At the latter chainage-point the irregularly-branching drift cuts through altered andesitic rock to 338 feet. From here to 455 feet conditions are complex with irregularly-trending, narrow zones and patches of silicified granite lying between areas of diorite and andesitic rock. The last 45-foot drift section to the face, in which there is another small stope, is largely in silicified granite and quartz, with diorite along the north-eastern wall. Just back of the face a narrow tongue of diorite cuts south-westerly through the granite.

No. 3 level, at 2,315 feet elevation, comprises 665 feet of workings. This footage includes the crosscut approach, 475 feet long, from which 110 feet of drifting has been done under the central part of the section stoped above No. 1 level. Mineralization at this horizon is sparse in the silicified granite. Intermediate between Nos. 1 and 3 levels, the No. 4 adit, at 2,450 feet elevation, is a crosscut, said to be 190 feet long, which is directed towards a point below the No. 1 level stope just north-west of the crosscut approach at the upper horizon. This working, from which no drifting or stoping is reported to have been done, was in bad condition for examination. At the south-eastern extremity of the old workings, No. 5 level, at 2,553 feet elevation, is a crosscut 75 feet long, the portal of which is 125 feet north-easterly from the south-eastern face of the No. 1 level drift. This working has not reached the shear-zone area.

Work done in the neighbouring area by the Hercules Consolidated Mining, Smelting, and Power Corporation includes an adit-crosscut adjoining tide-water near Fanny Bay, which, 409 feet long according to the Report of the Minister of Mines for 1934, was not examined by the writer.

Vancouver Island.*

Vancouver Island Gold Mines, Ltd. (N.P.L.).

This company is stated to own some thirty-five mineral claims and fractions, some of which are Crown grants, in the vicinity of Mineral Creek. The camp and workings are on Mineral Creek, a tributary of China Creek. They are reached by following the reconditioned railway-grade of the Alberni Pacific Lumber Company up China Creek for 8½ miles from the city limits of Port Alberni to the junction of Mineral and China Creeks at an elevation of 1,100 feet; thence by approximately 1½ miles of steep switchback road, passable by low-geared, short wheel-base cars and by caterpillar tractor, up China Creek to camp at an elevation of 2,600 feet.

The workings are on the steep easterly slope of the " V-shaped " valley of Mineral Creek; the lowest is a few feet above the creek-bottom and the highest is 200 feet above it. Although the slopes of the valley are very steep, averaging 35 degrees, they are covered by a heavy stand of tall timber and a light mantle of glacial till. The timber is mainly fir, hemlock being scarce, and, although not of merchantable grade, is quite good enough for mine-timber.

The rock formation is highly-altered greenstone, which consists of slightly porphyritic, amygdaloidal, and tuffaceous varieties. The average strike of these rocks, as determined from the well-bedded tuffs, is north-south, the dips averaging 25 degrees westerly. Three main quartz veins, known as the *Mac*, *Belcher*, and *Dunsmuir*, follow well-developed shears; of these the *Mac* and *Belcher* veins strike north-westerly and range in dip from 40 to 55 degrees south-easterly, whereas the *Dunsmuir* strikes north-south and dips 80 degrees easterly. The quartz in these shears occurs partly as filling, but the dark-grey colour and the numerous " ghosts " of wall-rock fragments indicate that replacement of wall-rock, both that belonging to the shear and that adjacent to it, was the more important process. A small amount of pyrite and some free gold are the only minerals other than quartz in these veins.

The quartz in the veins is of varying ages. The earliest occurs as hair-like stringers contained only in the included fragments of wall-rock. These veinlets terminate against a later dark-grey quartz that has replaced considerable wall-rock. This in turn is traversed by veinlets and large masses of watery-white quartz. The vein-pyrite occurs as fine grains in numerous paper-thin ribbons of gouge roughly parallel to the vein-walls and as disseminated grains in both grey and water-white quartz. The sporadic visible gold occurs either with such pyrite-seams or as discrete grains in both grey and white quartz; the small amount occurring, vitiating any conclusion as to which quartz was preferred in the gold-deposition. Numerous calcite-seams, 1 mm. or less in thickness, traverse the veins, conspicuously at right angles to

* By J. S. Stevenson.

and directly across the gouge ribbons, and are evidently later than these. The older reports indicate that some sphalerite occurred in the quartz veins, but none was seen by the writer at the time of his examination.

In addition to the quartz veins a carbonate-zone outcrops in the creek-bottom; it consists of andesite and tuff that have been sheared in a north-south direction over a width of approximately 40 feet. The development of ankeritic carbonate, numerous hair-like stringers of quartz, and occasional irregular pyrite veinlets, combined with kaolinitization, have so altered the sheared rock that it is now buff-coloured on fresh surfaces and rusty-coloured on exposed ones. Examination of the sheared rock under a microscope is necessary to establish the andesitic or tuffaceous nature of different portions of this highly-sheared and altered rock.

The shear-zone follows the shearing, which ranges in strike from north 10 degrees east to north 20 degrees west and dips 70 degrees easterly.

The description of the workings will be in two parts, the first devoted to the quartz veins and the second to the shear-zone.

The quartz veins have been developed by surface-strippings, most of which have either sloughed or have been covered by dumps from the adits, and by five adits in which small amounts of stoping have been done.

Five adits have been driven on the quartz veins. They include the lower *Mac* adit at an elevation of 2,627 feet; the upper *Mac* adit at an elevation of 2,715 feet and 120 feet north 27 degrees east from the lower *Mac* adit; the lower *Belcher* adit at an elevation of 2,781 feet and 175 feet south 85 degrees east from the lower *Mac* adit; the upper *Belcher* adit at an elevation of 2.900 feet and 210 feet north 22 degrees east from the lower *Belcher* adit; and, finally, the *Dunsmuir* adit at an elevation of 2,876 feet and 390 feet north 15 degrees west from the upper *Belcher* adit.

The lower *Mac* adit has been driven from the portal as follows: North 33 degrees east for 15 feet; north 80 degrees east for 10 feet to where the *Mac* vein, striking north 45 degrees east and dipping 40 degrees south-easterly, is first intersected; north 42 degrees east for 75 feet along the vein (to point A); from here a short crosscut has been driven south 45 degrees east for 15 feet and from it a short drift south 45 degrees west for 15 feet along a branch vein striking north-easterly into the main *Mac* vein. At the end of this drift a raise has been driven north 45 degrees west for 30 feet to break through at the surface at a point on the *Mac* vein 35 feet south 10 degrees east from the portal of the upper *Mac* adit; from point A (above) the main drift has been continued north 42 degrees east for 15 feet, then north 82 degrees east for 30 feet, then swinging back on the vein in a direction north 47 degrees east for 35 feet to the face.

The upper *Mac* adit has been driven in a direction north 42 degrees east for 420 feet along the *Mac* vein. However, at this point the vein-shear has disappeared and 10 feet farther the *Dunsmuir* vein is intersected. A drift has been driven northward along this part of the *Dunsmuir* vein for 40 feet. Part of the *Mac* vein has been underhand stoped for a few feet along a section that extends from a point outside the portal where the raise from the lower *Mac* adit breaks through to the surface, to a point 25 feet in from the portal; and overhand-stoped to the surface along a section extending from the portal to 120 feet in; an overhand stope between here and 175 feet in had just been started before mining operations ceased. The vein in this adit strikes north 42 degrees east and dips 40 degrees south-easterly.

The *Mac* vein has been explored by two adits, a lower at an elevation of 2,627 feet and an upper at 2,715 feet. Where exposed in the lower adit the vein ranges from 3 to 18 inches in width, averaging 6 inches. Beneath the raise to the upper adit the vein-shear splits in two, one branch going south-eastward and consisting of frozen quartz and barren shear, alternating along the strike, and the other going north-westward and consisting of 2-inch stringers of quartz. The drift follows this latter shear, which converges towards the other as the face is approached. With the exception of a 10-foot thickness of well-banded tuffs near the portal, the rock in this adit is andesitic and has been strongly leached for an average of 6 inches on each side of the vein-shear.

In the upper *Mac* adit the *Mac* vein-shear is continuous for 420 feet, averaging 5 inches throughout most of this length, although ranging from a narrow vein-shear to sections of banded quartz 12 inches in thickness. In and adjacent to this adit the rock formations include a 10-foot band of tuff 15 feet south from the portal, amygdaloidal greenstone from the portal

to 140 feet in; then massive andesite to 200 feet in; then a zone of andesite in which layers of well-banded tuff are common. This zone extends to within 70 feet of the face of the drift, the rock in this latter section consisting of typical andesite. It may be noted that the orientation of the ovoid amygdales indicate that these andesitic flows conform in attitude to the tuffs. From the portal to the point where the tuffs commence the vein is tight and well defined and is accompanied by marked bleaching of the wall-rock; but throughout the greater part of the zone of alternating tuffs and andesite the vein loses its typical banded appearance, becomes very irregular, and frequently only the vein-slip is present. However, quartz comes in again occurring as stringers over a 50-foot transition zone into tuff-free andesite; only to string out again north-eastward into the shear and to disappear as the 40-foot north-south section of the *Dunsmuir* vein is approached. Cross-faulting of the vein is uncommon; in one place it has been moved a maximum of 10 feet transverse to its strike. It may be mentioned that the numerous small normal faults cutting and displacing the tuffs do not appear to affect the main vein-shear.

The lower *Belcher* adit has been driven north 13 degrees east for 55 feet and easterly for 200 feet; this crosscut intersecting the *Belcher* vein at 150 feet. From where intersected, the *Belcher* vein, dipping 50 degrees north-easterly, has been followed by a sinuous drift in a direction north 15 degrees east for 235 feet. At 135 feet along this drift from the crosscut a raise has been driven in a direction north 65 degrees west to break through into the upper *Belcher* adit at a point 40 feet in from its portal. At 200 feet along the lower *Belcher* drift from the crosscut a short working has been driven south 57 degrees east for 75 feet to intersect a small vein striking north and dipping 55 degrees easterly.

The upper *Belcher* adit has been driven in a direction north 27 degrees east for its full length of 380 feet along the *Belcher* vein and vein-shear, which dips 50 degrees south-easterly. A little underhand stoping has been done on the vein for 40 feet north-easterly along the drift from the raise that comes from the lower *Belcher* adit; and from the inner end of this stope, which is 80 feet in from the portal, to 180 feet in, an overhand stope has been commenced on the vein.

Two adits have been driven on the *Belcher* vein, an upper at an elevation of 2,900 feet and a lower at 2,781 feet. The full length of the upper adit, 380 feet, is a drift on the vein-shear. The *Belcher* vein commonly ranges from 1 foot to 6 inches in width, although an occasional lenticular thickening to 4 feet and a narrowing to a few 1-inch stringers are common. The quartz, containing scattered bunches of pyrite, is quite frequently ribboned by jagged or saw-tooth partings of crushed rock $\frac{1}{32}$ inch or less in thickness. Towards the face the quartz becomes less, but the shear continues. The shearing accompanying the *Belcher* is much wider than that with the *Mac* vein. The *Belcher* shear varies from 1 to 4 feet in width and frequently is accompanied by brecciated wall-rock that has been thoroughly leached and impregnated by pyrite and narrow veinlets of watery quartz. Tuff is not abundant in this adit, occurring only as thin beds at 200 and 300 feet from the portal.

The short adit above and 85 feet north 23 degrees west from the upper adit intersects 10 feet of tuff and shows, in the face, a lenticular 2-foot by 6-inch segment of ribboned quartz contained in a fault-zone. Its discontinuity and association with strong shearing suggest that the quartz is drag-ore from some larger vein. It is locally known as the Intersection vein.

The lower *Belcher* adit begins as a short drift on a shear partly filled with quartz and known as the *Chicago* vein. Cribbing prevented a good examination of this vein. The working turns at 60 feet from the portal and crosscuts to the *Belcher* vein. In this lower adit the vein-shear, though continuous, is tighter and the quartz much less continuous; the vein is also narrower, varying from a maximum of 2 feet to mere stringers. In the face of the crosscut nearest the end of the drift a 10-inch vein of ribboned quartz and pyrite has been intersected. Brecciation and leaching of the wall-rock is still common. From the portal to the intersection of the crosscut with the vein the rock is fine-grained andesite; in the westward continuation of this crosscut, the drift and the accompanying workings northwards, the rock is amygdaloidal. A zone of tuff occurs near the face of the drift.

The *Dunsmuir* adit has been driven as a crosscut south 84 degrees east to intersect the vein 75 feet in, but because of vein faulting it has been continued another 25 feet; from here a drift has been driven along the vein north 4 degrees east for 160 feet and south 4 degrees west

for 25 feet more (ground was badly caved when examined). Owing to caving ground the extent of stoping was hard to determine, but overhand stoping appears to have been done between points 50 and 110 feet respectively from the crosscut.

The crosscut from the portal of the *Dunsmuir* adit intersects 1 foot of a well-defined vein of ribbon-quartz, which has been indefinitely faulted approximately 15 feet eastward, the main drift following the northerly continuation of this vein. At the intersection of the drift and the crosscut the back displays a plexus of quartz veins in leached wall-rock over a width of 12 feet. The vein in the main drift consists of ribbon-quartz varying in width from 10 inches to mere stringers in the vein-shear near the face. The rock in this working is mostly tuff; from the portal to 50 feet in tuffs predominate; from here to the east wall of the drift medium-grained andesite is found; but from the back of the caved winze and striking along the drift the tuffs occur, first only on the east wall, then partly in the back, until in the face they occur across the full width of the drift. They strike approximately north 10 degrees west and dip 50 degrees westerly. Wall-rock brecciation and alteration, manifested in the development of carbonate, kaolin, and pyrite, is common in the andesite, but practically lacking in the tuffs. It may be noted that the old stope and the open-cut above are in the andesitic greenstone.

The shear-zone is a zone of tightly-sheared and carbonatized greenstone occurring on the easterly side of the valley of Mineral Creek, a creek that flows southerly past all the workings.

Workings on the shear-zone comprise twelve strippings and two adits, a lower adit at an elevation of 2,800 feet and an upper adit at an elevation of 2,932 feet, 285 feet north 10 degrees east from the lower adit. All these workings have been driven eastward from near creek-level, and in describing the position of the strippings directions will be given to the westerly or creek end of each stripping.

No. 1 stripping is 35 feet south 30 degrees east from the portal of the lower adit.
No. 2 is 40 feet north 10 degrees east from the same portal.
No. 3 is 20 feet north 8 degrees west from No. 2.
No. 4 is 35 feet north 40 degrees east from No. 3.
No. 5 is 30 feet north 15 degrees east from No. 4.
No. 6 is 30 feet north 2 degrees west from No. 5.
No. 7 is 45 feet north 20 degrees east from No. 6.
No. 8 is 75 feet north 6 degrees east from No. 7.
No. 9 is 50 feet north 3 degrees west from No. 8.
No. 10 is 50 feet north 10 degrees east from No. 9.
No. 11 is 50 feet north 3 degrees east from No. 10 (elevation 2,960 feet).
No. 12 is 35 feet north 15 degrees east from No. 11.

The lower adit has been driven north 50 degrees east for 50 feet, then branched, a short crosscut being driven easterly for 30 feet and a main drift driven along the general shearing of the rocks north 10 degrees east for 130 feet to the face. Sixty degrees back from the face of this drift a crosscut has been driven north 70 degrees west for 42 feet to a working-face.

The upper adit has been driven north 72 degrees east for 25 feet to the face.

The upper adit, at elevation of 2,932 feet, cuts across buff-coloured rock that has been sheared in planes, 2 inches apart, striking north 20 degrees west and dipping 70 degrees easterly. The rock contains disseminated pyrite and numerous veinlets of watery quartz. That faulting attended by displacement occurs is exemplified by a fault in the adit 6 feet from the face striking north 20 degrees east and dipping 45 degrees easterly, which has displaced a 1-foot band of black mineralized quartz a minimum distance of 10 feet along the working. An estimated minimum displacement of 25 feet must have occurred in the plane of the fault.

The lower adit on the shear-zone, at an elevation of 2,800 feet, is mostly within the buff-coloured rock typical of the shear-zone, although blocky tuff occurs in the face of the drift and in the crosscut to the east. Strike-faults containing a considerable amount of gouge are common; the strongest fault, striking north 10 degrees west and dipping 70 degrees north-easterly and intersected at a point 65 feet from the portal, averages 4 feet in width and contains much crushed rock and black gouge.

The shear-zone was sampled extensively by chip-sampling, some seventy-nine samples being taken. A tabulated description of these follows. Because of the presence of considerable spotty free gold in the main quartz veins these were not sampled.

Length of Sample.	Gold. Oz. per Ton.
Trench No. 1—	
Three continuous 5-foot samples over 15 feet, average	0.007
Trench No. 2—	
Five continuous 5-foot samples over 25 feet, average	0.026
Trench No. 3—	
Six continuous 5-foot samples over 30 feet, average	0.025
Trench No. 4—	
Seven intermittent 5-foot samples over 35 feet, average (ground oxidized and sloughed)	0.07
Trench No. 5—	
Two 5-foot samples on vertical faces, average (trench badly sloughed)	0.04
Trench No. 6—	
Too badly sloughed.	
Trench No. 7—	
Five feet in uppermost trench, average	0.02
Five feet in lowermost trench, average	0.06
Trench No. 8—	
Four intermittent 5-foot samples, average	0.04
Trench No. 9—	
Six continuous 5-foot samples, average	0.06
Trench No. 10—	
Five continuous 5-foot samples	0.085
Recheck with four continuous 5-foot samples	0.065
Trench No. 11—	
Badly sloughed—only one 5-foot sample	0.03
Trench No. 12—	
Seven continuous 5-foot samples	0.03
Average of above cuts representing a shear-zone length of 500 feet	0.05
Shear-zone, *upper* adit—	
Five continuous 5-foot wall samples from face outwards, average	0.05
One 3-foot sample at portal	0.06
Four continuous 5-foot check samples from portal in, average	0.085
Shear-zone, *lower* adit—	
(*a.*) 10-foot continuous samples from face of first crosscut south-westwards to portal of adit—	
Face to 10 feet	0.16
10 feet to 20 feet	0.08
20 feet to 30 feet, three samples, average	0.02
30 feet to 40 feet	0.06
40 feet to 50 feet	0.02
50 feet to portal	Trace
Average, 0.058.	
(*b.*) Samples from new crosscut on west side of main drift; samples listed from drift towards working-face of crosscut—	
Drift to 5 feet	0.01
5 feet to 10 feet	0.02
10 feet to 15 feet	0.01
15 feet to 20 feet	Trace
20 feet to 25 feet	Trace
25 feet to 30 feet	*Nil*
30 feet to 37 feet	Trace
37 feet to 42 feet	Trace
(*c.*) 3-foot westerly sample across face of main drift	0.04
2-foot easterly sample across face of main drift	0.02

Descriptions of this property, referred to in the older reports as the "Alberni Consolidated" and comprising the *Alberni* group of claims, may be found in the following Annual Reports of the Minister of Mines: 1895, 1896, 1897, 1898, 1933, and 1934.

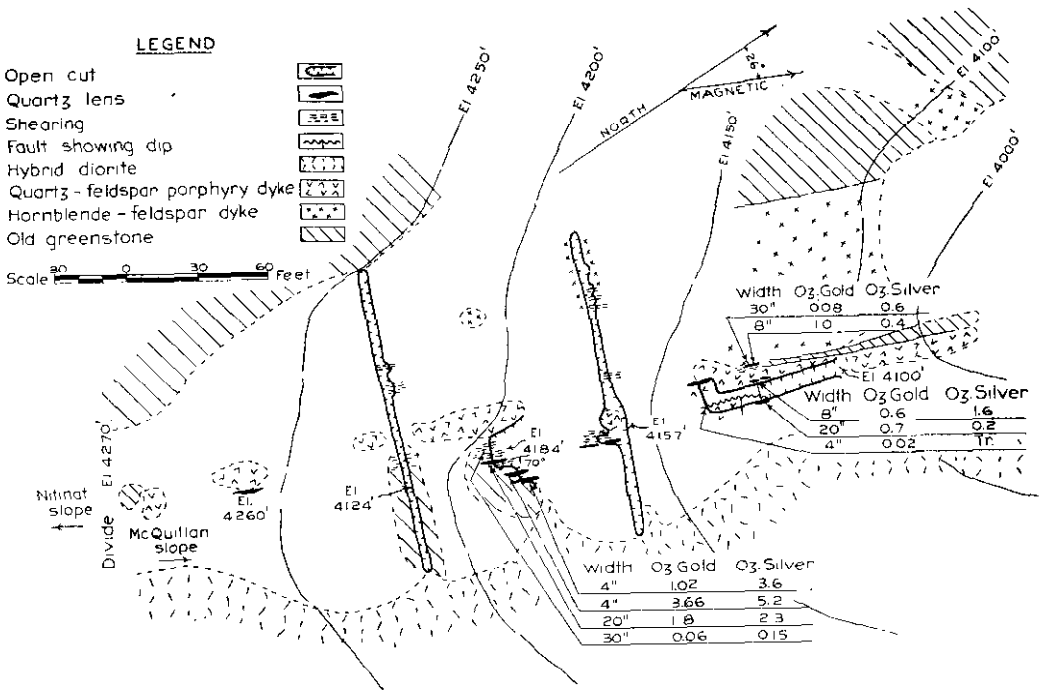
The original group of four Crown-granted claims, the *Alberni, Chicago, Warspite,* and *Victoria,* were staked in 1895 and acquired by Dunsmuir interests; in 1897 an English company acquired the property and operated for two years, after which time there is no record of activity until the spring of 1933, when R. W. Williams leased the reverted Crown grants and later in the year optioned them to the Vancouver Island Gold Mines, Limited, which was organized in September, 1933. This company has increased its holdings to include the present holdings stated of thirty-five claims and fractions.

The early work on the property consisted of sinking a shaft, driving a crosscut and drift on the *Dunsmuir* vein, extracting small amounts of ore from it, and open-cutting and a small amount of stoping on the *Belcher* vein. It is recorded in the Minister of Mines' Report for 1897 that several lots of ore aggregating 30 tons had been shipped out to be tested, and in the 1898 Minister of Mines' Report that an 8-stamp mill was erected and two clean-ups were made. In 1933 R. W. Williams sampled and dewatered the shaft, then turned the property over to the present company, which, after further stripping and open-cutting, drove the upper and lower *Mac* and *Belcher* adits, and in 1936 the two shear-zone adits. Early in the summer of 1936 a 35-ton pilot-mill was installed; but, consequent upon difficulties of operation, the mill was closed early in the fall and operations were suspended on the property.

Havilah Gold Mines, Ltd.

This company owns the *Red Rose, White Rose, Pink Rose, Yellow Rose,* and *Spike Nos. 1–4,* inclusive, mineral claims. Of these claims the *White Rose* and *Red Rose* were staked in August, 1934, and the remainder in February, 1936, all by Walter Harris. They are between elevations of 3,500 and 4,300 feet at the head of McQuillan Creek, the main southerly tributary of China Creek, a large creek flowing westward into Alberni Canal.

The property is reached by following the abandoned railway-grade of the Alberni Pacific Logging Company. This grade has been made suitable for the automobile traffic as far as the junction of McQuillan and China Creeks at a point 11½ miles eastward from the city limits



Havilah Gold Mines, Ltd. Sketch-plan of Workings.

of Port Alberni, or 3 miles beyond the branch road to the Vancouver Island Gold Mine. At the time of the author's examination a trail led from the junction of these creeks at an elevation of 1,300 feet to the camp at an elevation of 3,550 feet; of the 4 miles of trail, 2 miles were on a gentle grade and 2 on a very steep one. It is stated that a narrow-gauge road has been built from the junction of the creeks for 3 miles to King Solomon Basin, a basin not entered by the old trail. A pack-horse trail has been constructed from this basin to the camp and workings. The total distance from Port Alberni is 11½ miles by auto-road, 3 miles by narrow-gauge road, and 1 mile by pack-horse trail.

The workings on the property will be described under two main headings—the lower workings on the *Gillespie* vein and the upper workings on the *Alberni* and *McQuillan* veins.

The lower workings, at an altitude of 3,500 feet, are on the westerly side and near the bottom of a north-south-trending cirque. The upper workings, between altitudes of 4,000 and 4,300 feet, are at the head of this same cirque, the uppermost being just below the divide between McQuillan and Nitinat Creeks. The hillside in the vicinity of all these workings is very steep, the lower slopes covered by scrub fir and snow-brush, and the upper by large talus boulders. Suitable mine and domestic timbers are abundant on the hillsides immediately below the lower workings and abundant water is furnished by McQuillan Creek.

The lower workings are on a tabular quartz vein, the *Gillespie*, that has been shown by five cross-trenches to extend for 650 feet on a 35-degree slope, ranging in strike from north 10 degrees to north 65 degrees east, dipping 70 degrees east, and ranging in width from 2 feet to 3 inches. It is not markedly lenticular, but appears to narrow to the south, and to the north is seen as three narrow, tight 2-inch stringers in andesite. The rock formation near by is massive augite andesite, now a greenstone, that has been badly shattered close to the vein. The metallic minerals in the vein include abundant pyrite, sphalerite, and galena, with smaller amounts of chalcopyrite and arsenopyrite.

The main working on the *Gillespie* vein is a cut at an elevation of 3,500 feet closest to and 100 feet west from the cabin. Here a combined cut and stripping expose the main vein for a strike-length of 20 feet. This vein is quite tabular over its explored length, strikes north 05 degrees east, dips 70 degrees easterly, ranges in width from 15 inches to 20 inches, and consists of quartz containing bands of abundant sulphides. Over a 5-foot width in the hanging-wall of this vein the wall-rock is sheared and contains lenticular quartz-sulphide veins of varying attitude, ranging from 1 to 4 inches in width. However, this zone does not continue for more than 15 feet along the strike; the occurrence of numerous quartz-sulphide veinlets at this point having been localized in the acute angle between the slight amount of shearing accompanying the main vein and the shear accompanying a 4-inch quartz veinlet farther to the east and striking north 10 degrees west; eastward beyond this shear the wall-rock is unsheared and unmineralized. The sulphides include abundant pyrite, galena, and sphalerite accompanied by minor amounts of chalcopyrite and arsenopyrite.

The results of sampling this cut are:—

Gold.	Silver.	Lead.	Zinc.	Description of Sample.
Oz. per Ton.	Oz. per Ton.	Per Cent.	Per Cent.	
0.20	2.2	0.4	0.23	Across 19 inches of banded vein-matter in the main vein.
0.28	0.9	. ..	.....	Ditto, but 10 feet farther south.
0.06	0.4	Trace	0.28	Across 63 inches of sheared andesite containing narrow quartz-sulphide veinlets.
0.26	1.0	Trace	0.30	Across 4 inches of rusty quartz in the extreme hanging-wall of the shear area.
0.02	Trace	. . .	. ....	Across 60 inches of slightly sheared andesite 10 feet south from the 63-inch sample, indicating decrease in mineralization and values northward away from the junction of vein-shear with a branch shear.

The *Gillespie* vein is exposed in two other trenches southward from this main trench and cut. In a trench 48 feet south 18 degrees west and 16 feet higher, a tabular 3-inch quartz vein occurs which may be correlated with the *Gillespie*. In another trench and stripping, 180 feet south 20 degrees west and 75 feet higher than the main cut, the vein has been exposed

for a strike-length of 40 feet, showing an average width of 1 foot over that distance and containing abundant sulphides. Three samples, all oxidized, taken across 12 inches at the base of this exposure assayed: Gold, 7 oz., 1.9 oz., and 1.68 oz. per ton; silver, 3, 1.7, and 2.8 oz. per ton respectively; and a 12-inch sample taken across the vein at the top of the exposure assayed: Gold, 2.22 oz. per ton; silver, 0.2 oz. per ton.

A third trench, 130 feet south 20 degrees west and 100 feet higher than the last, failed to intersect the vein, although driven across its probable projection. It is possible that since the last exposure—namely, 8 inches of tabular vein 80 feet north 20 degrees east from here—the vein may have pinched, or it may be that the trench, which is only 20 feet long, was not extended far enough either east or west to cross the vein. The rock in the trench is blocky greenstone and indicates considerable shattering.

Northward from the main cut nearest the cabin two other trenches have been dug across the extension of the *Gillespie* vein. The first, 370 feet in a direction north 12 degrees east and 200 feet lower in elevation, is a 30-foot cut that has been dug across the face of the steep hillside and exposes two 12-inch zones of shearing 10 feet apart, consisting of rusty, blocky greenstone and narrow veinlets of quartz. Samples across each of these zones assayed: Gold, 0.08 and 0.12 oz. per ton respectively; and silver, 1 oz. per ton and a trace. A second similar trench and a cut 12 feet long dug in a north-south direction, 45 feet in a direction north 12 degrees east from the last and 30 feet lower in elevation, exposes an 8-inch oxidized zone of decomposed rock, a 1-inch rib and several small fragments of mineralized quartz. A sample of this material assayed: Gold, 0.02 oz. per ton; silver, trace. The rock in this cut is sheared and decomposed over a width of 5 feet.

The probable continuation of the *Gillespie* vein northward is exposed in the bed of McQuillan Creek approximately 150 feet north 15 degrees east from the last trench, where it occurs as three 1- to 2-inch tight quartz veinlets with the usual strike in hard massive andesite, all evidence of shearing being absent.

The geology in the vicinity of the upper workings is complex. Old greenstones, some definitely andesitic, and others appearing to be shattered tuffs, contain irregular and lenticular feldspar dykes that are highly altered. These include light-coloured, hornblende-feldspar dykes and a conspicuous, coarse-grained quartz-feldspar porphyry dyke, which has the same attitude as the veins. All these rocks have apparently been intruded by a granitic rock now lying to the east as a large body of coarse-grained hybrid diorite. Half a mile northward across the basin in some high reddish-weathering bluffs, the porphyry dyke has been transected and partly replaced by a large area of fresh, dense diabase, which is, however, cut by a strong, tabular quartz vein. No acid intrusives that could be correlated in appearance with typical Coast Range granodiorite were found; the veins probably being the only representatives.

In the upper workings two veins are exposed, the *McQuillan* in a short adit and the *Alberni* in open-cuts above this adit. The adit, at an elevation of 4,100 feet, is 1,900 feet in a direction south 4 degrees west from the main cut of the lower workings near the camp and is 600 feet higher in elevation. This working has been driven 36 feet as an open-cut and 21 feet as an adit in a direction south 15 degrees west; from the face a short crosscut was driven 8 feet westward. Over a 16-foot width the face of the open-cut, above the back of the portal and for 10 feet upwards, contains three shears, striking north 5 degrees east and dipping 70 degrees easterly. The most easterly is 20 inches wide and includes 3 inches of quartz and sulphides on the foot-wall. The middle shear is much narrower and contains a sulphide-quartz lens ranging from 1 to 8 inches in thickness. The most westerly shear constitutes a 3-foot layer of sheared andesite intervening between the quartz porphyry and the feldspar porphyry lying westward therefrom. The shear—assaying alone only: Gold, 0.08 oz. per ton; silver, 0.6 oz. per ton—contains a short lens of quartz of 8 inches maximum thickness which assayed: Gold, 1 oz. per ton; silver 0.4 oz. per ton. Underground the easterly shear tightens, being recognized in the back only as a tight slip and in the face as a 4-inch width of silicified porphyry containing abundant pyrite. On each side of this slip the pyritiferous material assayed: Gold, 0.2 oz. per ton; silver, trace.

The centre shear becomes an 8-inch sulphide-quartz lens that continues southward, but northwards ends against a slip. The vein-matter assayed: Gold, 0.14 oz. per ton; silver, trace. A tight slip showing in the back of the drift and striking north 30 degrees east seems

to have moved both shears a few feet westwards. The central shear and contained quartz has been called the *McQuillan* vein; the other two are unnamed.

The *Alberni* vein is a zone of intensely-sheared greenstone, averaging 10 feet in width, that contains from one to three lenticular veins of quartz and heavy sulphides, including abundant pyrite, sphalerite, and galena, and smaller amounts of chalcopyrite and arsenopyrite. These lenses vary in width from 4 to 24 inches, ranging in strike from north 20 degrees to 25 degrees east and in dip from 65 degrees to 70 degrees north-east.

The first cut above the adit exposes a 5-foot width of shear-zone occurring in the hanging-wall of the quartz porphyry and containing a 4-inch quartz-lens that pinches southwards, sulphides being abundant. Westward in the trench leading from this cut, several small shears, averaging 4 inches in width, contain rusty fragments of rock and quartz vein-matter. Sulphides are scarce.

The main showing on the *Alberni* vein is in the second cut and trench above the adit. Here the zone of imperfectly-sheared rock is 15 feet wide and contains three ribs of quartz, 4 inches, 4 inches, and 24 inches in width, and a rib of silicified wall-rock. These ribs are slightly lenticular, narrowing gradually either north or south along the strike. Assays of vein-matter are shown on the accompanying plan. The foot-wall of the zone is sharply marked by quartz porphyry, whereas the hanging-wall consists of blocky greenstone, bounded on the east by a wall of hybrid diorite.

The third trench above the adit is long and narrow. Where it crosses the projected position of the shear-zone the rock is badly shattered greenstone, showing a little rust but no quartz veins. Forty-six feet above this trench there is a small untrenched showing of quartz on the east wall of the quartz-porphyry dyke.

A strong quartz vein, striking north 25 degrees east and dipping 65 degrees north-east, occurs in some high diabase bluffs on the eastern side of the basin, the bottom of the vein in the base of the bluffs being at an elevation of 3,700 feet, approximately 400 feet above the bottom of the basin, and a quarter of a mile in a direction north 20 degrees east from the main *Alberni* showings. The intervening ground consists of the talus-strewn slopes and bottom of the basin. The vein, ranging from 1 to 2 feet in width, is banded by occasional sulphides, including pyrite and galena. An oxidized sample taken across 2 feet of the exposed surface of the vein assayed: Gold, 0.16 oz. per ton; silver, 0.6 oz. per ton. The immediate wall-rock is a dense diabase containing disseminated grains of pyrite; these are not related to the sulphide mineralization. It is important to note that 10 feet westward the diabase includes portions of a quartz-porphyry dyke, similar in attitude and appearance, and in the projected position of that found in the *Alberni* and *McQuillan* workings. It is to be noted, however, that tongues of diabase cut across this dyke, isolating large blocks of it, indicating that the diabase is later. The vein, however, is quite uninterrupted by the diabase and is therefore later. The diabase in these bluffs extends approximately 200 feet north and south from the vein; on both sides bounded by altered and definitely older andesite, which northwards grades into the hybrid diorite forming the eastern wall of the cirque.

As early as 1895 it is reported than an open-cut had been made on a vein on the then *King Solomon* claim, one of a group of four contiguous claims at the extreme head of McQuillan Creek. It is inferred that the vein referred to is that now known as the *McQuillan* vein, and the open-cut the same as that which leads into the old adit, known to have been driven by the old-timers. No descriptions of the property can be found since then. Most of the work has been done since the recent 1936 stakings. Mining operations were temporarily suspended in December, 1936, owing to adverse weather conditions for surface work.

The only previous description of the ground is in the Minister of Mines' Annual Report for 1895.

During the year 7 tons were shipped, yielding 15 oz. gold and 6 oz. silver.

Coquihalla River Area.

Home Gold Mining Co., Ltd.

Situated in the Yale Mining Division, the property of this company consists of eight claims held by location. The camp, at about 3,750 feet elevation, is at the head of the Middle Fork of Ladner Creek, 4½ miles north-westerly from Home Gold Siding, at 1,355 feet elevation, on the Kettle Valley Railway, about 27 miles from Hope. The mine-workings, between 3,830 and 4,300 feet elevation, reach

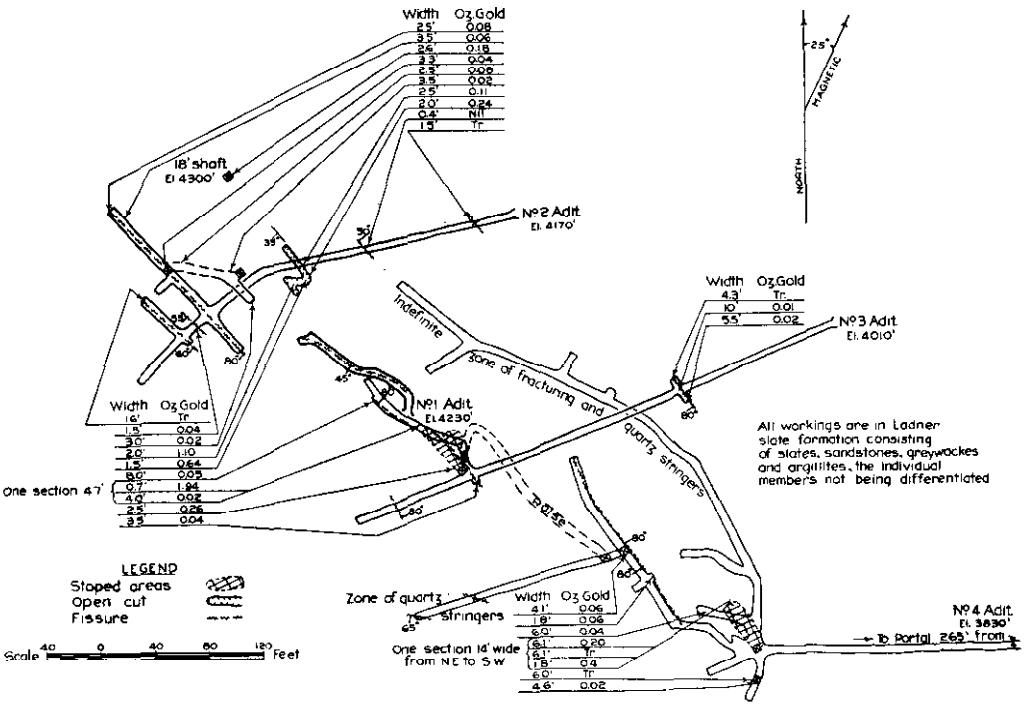
from the steep, wooded side-hill above the camp to the flatter ground forming the divide between the Middle Fork of Ladner Creek and the drainage area of Siwash Creek. Access to the property from the siding is by a caterpillar-tractor road, 6 to 8 feet wide, which climbs approximately 2,400 feet in a length of about 4½ miles. This road contains long, excessively-steep stretches as a uniform grade has not been sustained, height being lost by following benches and adverse grades. The property was originally reached by branch trail from the *Aurum* mine road. A favourable grade can be obtained by following the side-hill for about 2½ miles northerly from the *Aurum*, passing several prospects en route.

The geology of the area has been described in the following publications of the Geological Survey of Canada: Summary Report, 1920, Part A; Memoir 139, "Coquihalla River Area"; and Summary Report, 1929, Part A. The last mentioned contains a report on the property under *Pipestem* mine. It is situated entirely within the Ladner Slate Belt, tentatively assigned to the Jurassic, but not far from the contact with Late Palæozoic rocks of the underlying serpentine belt. The principal formation has been described as a rather massive, dark gray to black, tuffaceous sandstone, or greywacke, varying from close-grained to finely conglomeratic. The stratified rocks, including slates and argillites, have a north-westerly strike with variable, generally steep, south-westerly dips. Adjoining an old cabin, about 425 feet south 16 degrees east from the No. 1 level portal, there are outcrops of a porphyritic, greenish-grey dyke, 10 feet wide or more, striking north 35 degrees west, the dip not being exposed. Its composition, indicated by microscopic examination of a thin section, is from andesite to dacite.

Associated with a series of fractures and fault-fissures, which generally coincide with cleavage or bedding structures of the enclosing rocks, there are numerous silicified areas and zones of quartz stringers or lenticular bands of quartz. Irregularly disseminated pyrite is of widespread occurrence in such showings, gold values, according to the writer's samples, being from *nil* to 0.08 oz. per ton over widths of from a few inches to 10 feet. The more concentrated mineralization, as stoped, consists of pyrite and arsenopyrite occurring as streaks, bands, or small masses associated with silicified zones or quartz. A polished section examined microscopically was composed of relatively coarse, well-crystallized pyrite and arsenopyrite in roughly equal amounts in a quartz gangue with some carbonate material. In places the two sulphides were intimately associated. A green chlorite mineral is also present in this ore, two specimens of which assayed respectively: Gold, 2.02 oz. per ton and 0.88 oz per ton. Oxidation is generally confined to a depth of a few feet below the surface. The concentrations of better values, as at three points specified later, are associated with separate fissures and occur at different horizons.

References to past work on the property are contained in the previously mentioned publications of the Geological Survey of Canada and in the Annual Reports of the Minister of Mines for 1922, 1927, 1928, 1932, and 1933. Prior to the incorporation of the Home Gold Mining Company, Limited, in August, 1929, the property had been operated by the Pipe Stem Mining Company, Limited. The mill, which has a nominal capacity of from 5 to 6 tons per 8-hour shift, was operated intermittently during 1935 and 1936, small lots of concentrates and crude ore being shipped at intervals. Latterly development has been chiefly on the No. 4 level, where the principal work consisted of putting up a raise to the No. 3 adit.

The workings are shown on the accompanying plan. At the north-western end of the developed area an 18-foot vertical shaft adjoins an outcrop, now poorly exposed, of iron-stained rock containing quartz stringers. The sample across 2.8 feet, shown on the plan, was taken at 8 feet below the collar, conditions below this point being obscured by lagging. The open-cut south-easterly from the shaft exposed an outcrop of iron-stained, partly silicified rock containing irregular quartz stringers in a zone 2½ feet wide, up to 35 feet long, and exposed for 17 feet on the dip, assays indicating a concentration of values in this location. This showing, which dips 35 degrees south-westerly, could not be correlated with any similar structure in the No. 2 level workings to the south-west, as discussed later. Just above and north-easterly from the portal of the No. 1 adit there is a wide exposure of iron-stained schistose rock containing scattered quartz-streaks over a length of 25 feet, this showing being associated with fracture-planes striking north-westerly, with a 60-degree south-westerly dip. Conditions underground are briefly summarized as follows: With the exception of the two small stoped areas on the Nos. 3 and 4 levels, mineralization, associated with the fissures and fractures, is light and indefinite, quartz in lenses and stringers being of widespread distribution. The low gold



Home Gold Mining Co., Ltd. Plan of Workings. After Company's Plan.

content of such occurrences is indicated on the plan. There are no sulphide concentrations in the No. 1 and No. 2 adit-workings. The raise above the latter level is first vertical for 15.5 feet, then goes diagonally up the dip of a fracture for 53 feet on a 43-degree slope to the short sub-level. The raise then continues up on a 75-degree slope to the surface, this last section being inaccessible. Looking up this steep raise, there was no indication, such as might be afforded by lateral work, that the 35-degree south-westerly-dipping mineralized surface showing had been encountered.

As indicated on the No. 3 level, stoping of irregular outline has been done up to a length of 47 feet and over widths up to 14 feet. The larger stope here is reached from a vertical 24-foot raise at its south-easterly end. The irregular banded sulphide concentrations appear to be localized at the convergence of a fissure striking north 45 degrees west, with dips from vertical to 75 degrees to the north-east, and vertical fracture-planes striking north 25 degrees west. The crooked inclined raise which comes up under the stope from the No. 4 level did not encounter any valuable concentrations, no lateral work having been done from it.

The stope on the No. 4 level, reached from a 44-foot vertical raise, is 53 feet long, measured north-westerly on a 40-degree slope, up to 20 feet high, and up to 14 feet wide. A flat branch raise below the stope has been bulkheaded off. As in the case of the No. 3 level stope, the irregular local sulphide concentrations occur at the convergence of acute angled intersecting fractures.

The mill, of log construction, is situated in a gulch immediately below the No. 4 adit-portal, from which a track extends out on a trestle for 170 feet to a chute connecting with a storage-bin of about 70 tons capacity. The ore is fed through a 7- by 9-inch jaw-crusher to a fine-ore bin. The product, crushed to about ¾ inch in diameter, goes to a 3- by 4-foot Allis-Chalmers ball-mill in closed circuit with a 14-inch Simplex Dorr classifier. The overflow is treated in four Denver flotation-cells, the last two cells returning concentrates to the first two and the overflow tailing to waste. The concentrates from the first two cells are partially dewatered in three small wooden settling-tanks, and the concentrates finally dried over a specially-constructed stove-installation. Power for mill machinery is supplied by a Pelton wheel, which is

also coupled to a Gardner-Denver compressor delivering net, at this elevation, 115 cubic feet of free air per minute.

Vidette Lake Area.*

The Vidette Lake Camp may be reached by 43 miles of automobile-road northward from Savona, a small settlement at the west end of Kamloops Lake on the Cariboo Highway and on both the Canadian Pacific and Canadian National Railways.

The active area comprises that at the north-west end of the lake and includes the property of the Vidette Gold Mines, Limited, immediately adjacent to the lake; that of Savona Gold Mines, Limited, the workings of which are in a direction north 20 degrees west from the head of the lake; and that of the Hamilton Creek Gold Mines, Limited, whose workings are on the Hamilton Creek scarp south-westerly across the valley from those of the Savona Gold Mines. These companies have driven adits and inclines into the steep valley-walls bordering Hamilton Creek and Vidette Lake, whose common valley has been sharply incised to depths ranging from 250 to 400 feet in the extensive Bonaparte-Tranquille Plateau.

The rock formations include greenstone, small granitic dykes, and bosses, and on the plateau above and beyond the workings, basaltic lavas.

The greenstone is a variable augite andesite. The commonest type is porphyritic, but this may grade imperceptibly into massive fine-grained, equigranular phases; in the main adit of the Hamilton Creek property into amygdaloidal phases, containing calcite amygdales; and in the vicinity of shear-zones into greenstone-schist in which its porphyritic nature is destroyed, black, lustrous chlorite-planes of schistosity prevailing. Where massive and unsheared, the common type of greenstone is a dark-green rock that contains conspicuous prismatic crystals of augite averaging 1 mm. by 2 mm. in size, and brilliantly reflecting laths of feldspar averaging ½ mm. by 3 mm. in size; all embedded in a dense chloritic matrix. Under the microscope the rock is seen to possess a very definite porphyritic texture, wherein strongly-developed crystals of andesine-plagioclase and augite, which has largely altered to amphibole, are seen in a very fine-grained ground-mass. The rock may be termed an augite andesite.

The granitic rocks found both on the surface and underground, at the Vidette and Savona properties, may be descriptively called feldspar porphyries, although varying from granitic to monzonitic in composition. They are characteristically greenish-grey in colour, containing large feldspar phenocrysts, 5 mm. by 10 mm. in size, set in a medium-grained ground-mass. Under the microscope the minerals are seen to be large cloudy feldspars, both orthoclase and albite, smaller feldspars and subrounded quartz-grains, all surrounded by a fine-grained aggregate of hornblende decomposition products, consisting chiefly of fine-grained quartz and chlorite. It may be noted that the porphyry exposed in the Vidette main crosscut on No. 3 level lacks the quartz phenocrysts of the average type and is therefore more monzonitic in composition. Narrow, fine-grained dykes consisting of a granular intergrowth of white and pink feldspar occur underground at the Savona property. Microscopically these feldspar dykes are seen to consist of a mosaic of slightly-altered orthoclase and well-twinned albite, with a little interstitial quartz and a few aggregates of coarsely crystallized, obviously vein, calcite.

The veins are of the quartz-filled fissure type, and may or may not be accompanied by extensive shearing of the wall-rock. Mineralization has resulted in the development of pyrite, smaller amounts of chalcopyrite, and reported tellurides; gold frequently accompanies the above minerals, local experience indicating that the values are best when chalcopyrite accompanies the pyrite. Replacement of the wall-rock, though undoubtedly present, is not important, and leaching of the wall-rock is rare, the dark-green andesite being commonly in immediate contact with the quartz veins.

Faulting of varying ages is prevalent. Pre-vein fissuring, intra-vein faulting both during and after the mineralizing period and post-vein transverse faulting are all present.

Vidette Gold Mines, Ltd.

This company owns the following Crown-granted mineral claims: *Searcher No. 1, Pioneer, Searcher No. 3, Searcher No. 6, Searcher Fraction No. 1, Searcher No. 5, Percy, Myrta, Amy, T.F. Fraction, E.B. Fraction, Valley No. 1, C.E. Fraction, Argenta No. 1, Valley No. 2,* and *New Hope;* and the following mineral claims: *Searcher Fraction No. 2, Searcher No. 2, Searcher No. 4, Monarch, Lakeshore, Lakeshore Extension, Monument, H.A. Fraction, Comstock, Searcher No. 7,* and *Searcher No. 8.*

* By J. S. Stevenson.

The main workings are on the *Searcher No. 1* claim and consist of three adits and three shafts driven and sunk into the steep south-westerly-facing scarp of the Hamilton Creek-Vidette Lake Valley. These workings are on the *Tenford, Broken Ridge*, and *Bluff* veins. On the south-westerly side of Vidette Lake there are two short adits on the *Dexheimer* vein.

Inasmuch as the *Dexheimer* and early work on the Tenford veins have been concisely described by W. E. Cockfield,* only the *Broken Ridge* and *Bluff* veins, on which most of the subsequent work has been done, will be described in detail.

The rock formation consists of altered augite porphyry cut by feldspar porphyry. Although feldspar-porphyry dykes are common on the adjacent property of the Savona Gold Mines, Limited, only one intrusion, a dyke 30 feet thick in the third level main crosscut, was seen in the Vidette workings.

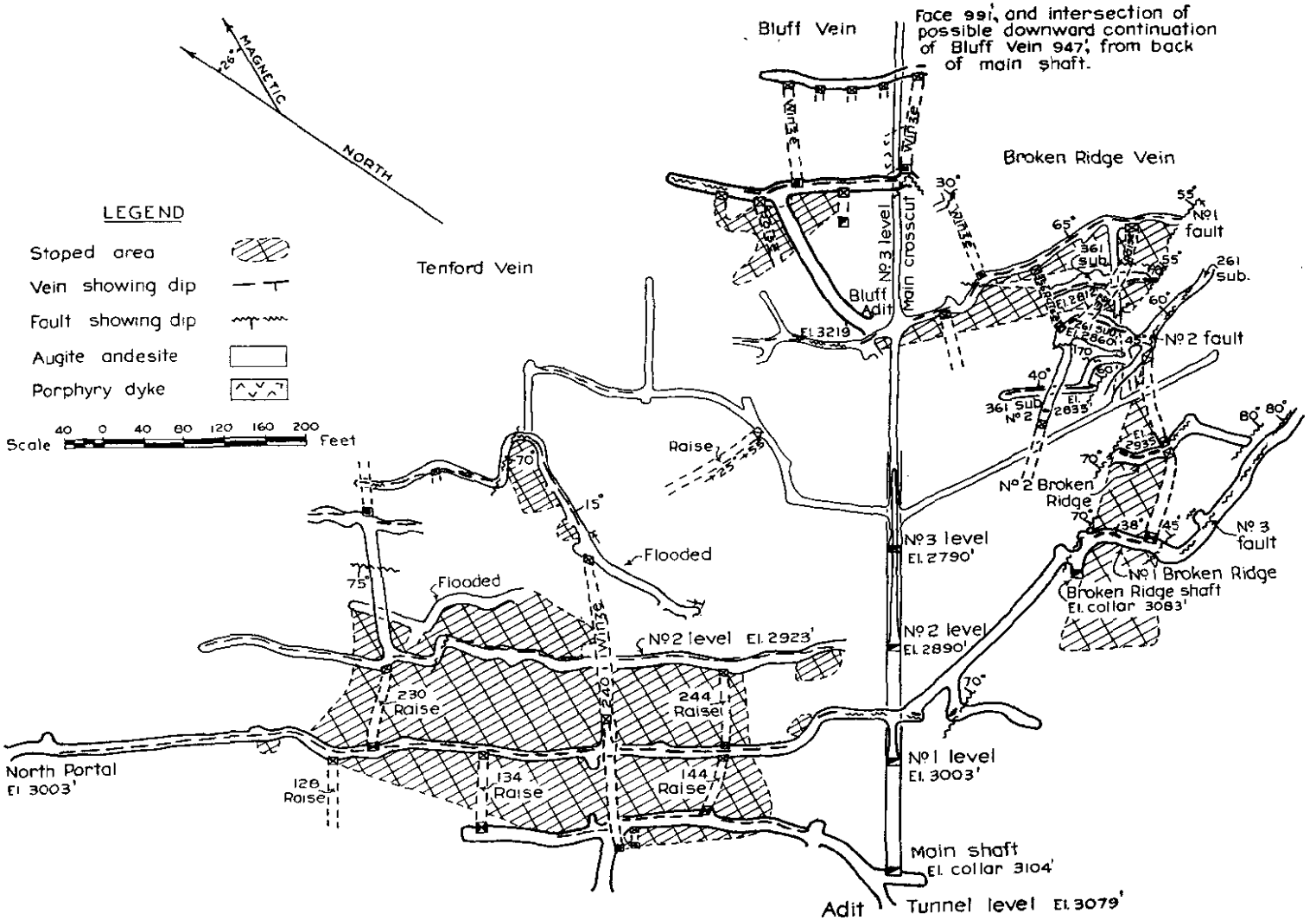
The quartz veins, listed in chronological order of development, are known as the *Dexheimer, Tenford, Broken Ridge*, and *Bluff* veins. They are of the quartz-filled fissure type and are characterized by a ribbon-structure which is manifested as paper-thin partings of both country-rock and graphite; this has been caused by superposition of different portions of the vein, effected by faulting in planes of similar strike and dip. To this feature, in part, may be attributed the variation in widths from a knife-edge vein-shear to a vein 4 feet in width. The general strike of the veins is north-westerly; the average dip 45 degrees north-easterly.

In addition to the intra-vein faulting as described above, there are two other groups of faults which displace the vein. The earlier of these consists of normal faults with strikes closely similar to those of the veins, but which have opposed dips, averaging 70 degrees south-westward, the veins dipping 45 degrees north-eastward. The information available has shown that displacement along these faults has been rotational; the observed displacements ranging from zero to 65 feet in the plane of the fault. These faults are not conspicuous, the width ranging from a crushed zone 1 foot wide to a knife-edge joint in the country-rock. The later group of faults is characterized by wide zones of intensely-crushed rock and gouge ranging in width from 1 to 3 feet. These vary in strike from north 80 degrees west to east-west and in dip from 45 degrees north to 80 degrees northerly. One measurement, indicating a horizontal movement of 220 feet in the plane of the fault, was the only displacement determinable at the time of the examination.

The filling in the Vidette veins consists predominantly of quartz containing sulphide-clusters which, in cross-sections of the veins, may range from 5 to 25 per cent. of the vein-matter. Pyrite is the main sulphide, but small amounts of chalcopyrite are common, and tellurides are reported to have been found in places. A study of polished specimens of the ore under the microscope shows that the pyrite-grains have been so shattered that, in some cases, 20 per cent. of the pyrite fragments average approximately 0.007 mm. and 40 per cent. approximately 0.25 mm. in size, even the larger, unbroken grains averaging 2 mm., being cut by numerous incipient fractures. Chalcopyrite commonly occurs as fracture-filling in the shattered pyrite, the veinlets, bounded by typical jagged and irregular walls, ranging from 0.007 mm. to less in width. It is also found as large, irregular, and unshattered areas surrounded wholly or in part by quartz gangue. The fractures in the larger pyrite-grains and the interstices of the pyrite fragments are filled by clear quartz, evidently later than the pyrite, and chalcopyrite, definitely transecting veinlets of the latter and replacing larger areas, leaving the chalcopyrite as cusp-shaped islands in a quartz-field. It is evident from the above mineral relationships that intense vein-shearing occurred subsequent to the formation of the pyrite, but previous to the formation of the chalcopyrite and present vein-quartz; it is probable that the gold was part of the chalcopyrite-quartz mineralization.

Numerous unbroken veinlets of calcite, averaging 0.007 mm. in thickness, transect all the minerals in the quartz veins. Thin films of crystallized gypsum (selenite) occasionally occur in joint-planes in the quartz. The gypsum is probably of secondary origin, having been precipitated from ground-water that, becoming acid by the oxidation of pyrite, dissolved calcium carbonate from either the walls or veins, and precipitated it in the form of calcium sulphate. The black, jagged fractures which aid in giving the veins a sheeted appearance contain films of black lustrous graphite, formed during the various intra-vein movements.

* Cockfield, W. E.: Geological Survey of Canada, Memoir 179, 1935, pp. 30–34.



Vidette Gold Mines, Ltd. Workings only from Company's Plan.

The *Broken Ridge* vein is exposed in the following levels: No. 3, 361 and 371 sub-levels; No. 2, 261 sub-level; and Nos. 1 and 2, *Broken Ridge;* also in raises and associated stopes from these and in a winze from No. 3.

On No. 3 level the vein-shear, striking north 55 degrees west and dipping from 65 to 40 degrees north-easterly, extends from the south-easterly end, where it is cut by a major fault, north-westward, stringing out against a vertical fault 70 feet north-westward from the main crosscut. The fault, striking north 25 degrees west, contains 2 feet of crushed rock and gouge; wall-flutings at 60 degrees from the vertical indicate that the most recent movement has been more nearly vertical than horizontal. On the south-east side of the fault and north-westwards towards the face there are narrow, quartz-pyrite stringers which may represent the continuation of the main vein. The strong fault on the south-easterly end of the drift, hereinafter referred to as No. 1 fault, is a zone of gouge and crushed rock ranging from 2 to 3 feet in thickness, striking north 80 degrees west and dipping 55 degrees northerly. This fault is recognizable in all the drifts above No. 3 level.

The character of the vein on this drift (No. 3 level) is variable; centrally between the ends of the drift it appears as a strong tabular vein between good walls, ranging from 1 to 3½ feet in width, the quartz containing abundant pyrite and chalcopyrite. However, towards each end it becomes broken, the quartz stringing out as narrow stringers or more commonly as disconnected lenses along the vein-shear. The vein continues as a tabular body down the winze for 60 feet to where it is cut by a small fault striking east-west and dipping 30 degrees northerly; the winze could not be examined beyond this point. It may be noted that thin films of crystallized gypsum (selenite) were found filling fractures in the quartz of the vein in the winze.

A normal fault intervenes between the ore on Nos. 3 and 361 sub-levels. This fault, striking north-west and dipping 70 degrees south-west, drops the south-easterly portion of the vein approximately 20 feet, but where it crosses No. 3 level effects no displacement; this habit indicates the rotational nature of the movement. In 361 sub-level the vein is for the most part tabular and strong. In one place, however, it narrows to a stringer, but shortly widens to a wedge 3½ feet thick, indicating a repetition of the true vein-width. To the north-east the vein is cut by No. 1 fault; at the intersection it was noted that the vein was bent and dragged eastward down the dip of the fault indicating that the continuation of the vein south-eastward may be found eastward along the fault.

The vein continues uninterruptedly from 361 to 261 sub-levels, occurring as a tabular portion ranging from 8 inches to 1 foot in width. However, a few feet above 261 sub-level a normal fault, striking north-westerly and dipping 70 degrees south-west, has dropped the vein approximately 60 feet down the dip of the fault-plane, the upper, down-faulted portion of the vein occurring in the 261 crosscut and in 361 sub-level, No. 2. In the latter level the vein is cut to the south-east by No. 1 fault. The most southerly portion of the 261 sub-level has been driven 100 feet along No. 1 fault, which here has been joined by a second, referred to as No. 2 fault. The latter, striking north 80 degrees west and dipping 45 degrees northerly, is similar in kind to No. 1.

Little is known of the continuation of the main part of the vein from the 261 level to No. 1 level. However, a triangularly-shaped block of ore, its apex at the 261 level and its base at the surface extending south from the *Broken Ridge* shaft, lay between Nos. 1 and 2 faults. The outline of the stope indicates traces of the intersections of this block with the faults, Nos. 1 and 2.

The only probable connecting-link between the *Tenford* and *Broken Ridge* veins is on No. 1 level, where a tight shear crosses the main shaft, carrying lenses of quartz in the hanging-wall. This shear continues south-eastward for 50 feet to intersect a strong fault correlated with No. 1. Sigmoid lenses of quartz, averaging 4 feet by 4 inches in cross-section, lie in the hanging-wall of this fault, indicating a displacement of the vein towards the east, a displacement similar in direction to that indicated at the intersection of this fault and the vein in No. 3 level.

The *Bluff* vein has been opened by a shaft, crosscut, two drifts, and connecting raises and stopes; the lower workings were flooded at the time of examination. As seen in these workings, the *Bluff* vein strikes north-west and dips 37 degrees north-easterly.

The tabular portions of the vein range from 6 inches to 2 feet in width, the latter thickness being due, however, to a threefold superposition of the vein, thin films of gouge separating the

layers of quartz. This feature is well displayed in the north-westerly winze from the upper drift. For the main part, the vein consists of quartz irregularly laminated by abundant sulphides. In the south-east end of the upper drift the vein is cut by two major faults—an older one, striking north 80 degrees east and dipping 55 degrees northerly, and a younger one, striking north 20 degrees easterly and nearly vertical. Although twisted lenses of ore, averaging 3 feet by 8 inches, occur in the re-entrant angle between these faults, the continuation of the vein beyond has not been followed. On No. 1 level the vein recurs 220 feet along the drift and on the south side of No. 1 fault. This portion of the vein, striking north 20 degrees west and dipping 38 degrees north-easterly, extends for 75 feet along the drift and then is cut by No. 2 fault; this is part of the triangularly-shaped vein-segment referred to previously. Work beyond No. 2 fault has encountered another strong fault, No. 3, which strikes east-west and dips 80 degrees northerly. It has been drifted on for 190 feet, but the continuation of the vein on the south side of the fault had not been found at the time of the present examination. However, the face showed, at that time, sigmoid lenses of quartz, 2 feet by 3 inches in size, containing abundant sulphides. No. 2 fault does not appear to cross No. 3, indicating that either No. 2 is a branch from No. 3 or that No. 3 has displaced a portion of No. 2 fault from some unknown position. Towards the north-west end of the drift the vein pinches and disappears in a strong fault 8 inches in width and of the same attitude as the vein.

At a point in the main crosscut of No. 3 level, 920 feet north-eastward from the back of the main shaft and in approximately the projected position of the *Bluff* vein downward, nearly horizontal lenses of vein-quartz and pyrite, averaging 12 inches in thickness, have been intersected and drifted on for 33 feet south-eastward. The amount of intensely-crushed rock accompanying this material indicates that it has been faulted into its present position probably from the extension of the *Bluff* vein downwards from the upper *Bluff* workings, some 345 feet higher in elevation.

The country-rock in the upper *Bluff* workings is the typical greenstone, augite porphyry.

The *Tenford* vein is exposed in those workings that lie north-west from the main shaft. W. E. Cockfield, in the Geological Survey of Canada Memoir 179, has described the *Tenford* vein as exposed, at the time of his examination, in the Tunnel, No. 1, and No. 2 levels, and in the connecting winzes and raises. Briefly, in recapitulation, the vein strikes about north 35 degrees west and dips 50 degrees north-easterly. It is narrow, the best portions ranging between 1 and 1½ feet in width. Towards the north-west end of the drifts the vein loses its tabular nature and splits into a few small stringers; but the vein-shear, though tight and recognizable in places only by a stringer or two of quartz, persists to and probably beyond the north-westerly limit of the workings. Towards the south-east and in the vicinity of the main shaft on the Tunnel and No. 1 levels the vein is cut by the same major east-west fault which cuts the *Broken Ridge* vein, and which has been referred to in the description of the latter as the No. 1 fault. One normal and one reverse fault occur down the dip of the vein below No. 1 level.

Below No. 2 level, in 270 drift and in a raise from No. 3 level, a faulted and rotated portion of the vein has been found. This portion, however, strikes approximately north-south and is quite flat, the dips ranging from 15 to 25 degrees east. It is not wide, the common width of the tabular portions ranging from 10 to 2 inches, although those lengths, which include unreplaced greenstone-partings, may be 1 foot in width. In 270 drift the vein has been cross-faulted by the only reverse fault so far recognized; the strike of this fault is north 75 degrees east, dip 70 degrees southerly, and the resultant horizontal displacement of the vein in the crosscut is 55 feet north-westward from 341.

Quartz veinlets, averaging 2 inches in thickness and containing small amounts of sulphides, occur, with very little accompanying shearing, in No. 3 level, north-westward from 341 crosscut. This may or may not be a downward continuation of the *Tenford* vein.

The *Dexheimer* vein has been opened by two short adits on the opposite side of the lake from the main workings. In the lower adit the vein occupies a shear either as a strong tabular body of quartz ranging from 2 to 6 inches in width, or as splitting stringers; all striking north 40 degrees west and dipping from 35 to 40 degrees north-easterly. The quartz contains some pyrite and chalcopyrite. The country-rock is typical augite porphyry.

History.—Most of the Vidette claims were located in 1931 and 1932 and were first optioned to D. B. Sterrett, present general manager, who carried out the first important operations on

the property and erected a small treatment plant. In October, 1932, a private company known as the Vidette Mines, Limited, was formed; this company carried on active development and enlarged the mill capacity to 25 tons per day. In May, 1933, the present company, Vidette Gold Mines, Limited (N.P.L.), was formed, and has carried on production, increasing the mill capacity to 45 to 50 tons daily, since that time.

Descriptions of the property may be found in Memoir 179 of the Canadian Geological Survey and in the Annual Reports of the Minister of Mines for the years 1931 to 1934, inclusive.

During the year 12,202 tons were mined and 12,352 tons milled. This yielded 8,269 oz. gold, 13,037 oz. silver, and 27,672 lb. copper.

Savona Gold Mines, Ltd.

This company owns the *Last Chance-Sylvanite* group of claims staked in 1931 and 1932 and acquired from the Sylvanite Mining and Development Company in 1934. Previous descriptions of the property may be found in Memoir 179 of the Geological Survey of Canada and in the Annual Reports of the Minister of Mines for 1933 and 1934. The main workings are on the *Last Chance* claim, and include two adits, the *Exploration* at an elevation of 3,095 feet, the 226 adit at 3,030 feet, and several open-cuts on vein-exposures, most of which have been intersected by the underground workings. The workings are all on the steep scarp which forms the eastern wall of Hamilton Creek Valley.

The rock formations include greenstone and intrusions of quartz-feldspar porphyry. The greenstone is traversed by numerous fissures and shear-zones, which strike north-westward and dip north-eastward. Numerous cross-faults cut and shears displace the vein-shears. These vein-shears contain bands and discontinuous lenses of quartz. A banding of the vein-quartz caused by films of mixed chlorite and fine-grained pyrite is common. Sulphides are not abundant; they include finely-disseminated pyrite in both the schistose greenstone of the vein-shears and in the chloritic ribbons of the quartz-bands, and small amounts of tetrahedrite, sphalerite, and galena, which were seen only in the surface showing of the *Argentite* vein. Besides quartz, the gangue consists of both white and pink calcite, the latter containing a small amount of manganese, and a deep-green chlorite which occurs as irregular areas within the quartz. No pyrite is associated with this hydrothermal chlorite.

The *Exploration* adit has two portals at 3,095 feet elevation, 330 feet apart, the one in a direction south 70 degrees east from the other. From the south-westerly portal a crosscut has been driven north 72 degrees east to the face at 326 feet. At a point 65 feet from this portal the crosscut intersects the *Argentite* vein, along which a drift has been driven south 45 degrees east for 40 feet; at 180 feet it intersects No. 3 vein; at 202 feet the *Sylvanite* vein. Here a main winze has been sunk at 66 degrees in a direction north 72 degrees east at the intersection of the crosscut and the drift from the south-easterly portal. At 255 feet the main crosscut intersects the *Yarvi* vein.

From the south-easterly portal a drift has been driven along a shear-zone north 40 degrees west for 70 feet; then, turning north-east for 6 feet, it continues, partly along the *Sylvanite* vein, north 30 degrees west for 145 feet to the winze at its intersection with the main crosscut.

The *Argentite* vein varies in strike from north 40 degrees west to north 47 degrees west and in dip from 80 degrees to 85 degrees north-eastward. The vein consists of quartz-lenses in a crushed zone. The lenses average 6 inches in length and vary from 2 to 4 inches in thickness. The crush-zone averages 18 inches in width. The sigmoid shape of some of the quartz-lenses indicates movement within the shear subsequent to the deposition of the quartz. Sulphides are scarce. A sample taken across the shear-zone and containing quartz assayed: Gold, 0.02 oz. per ton; silver, 0.2 oz. per ton.

No. 3 vein consists, in part, of ribboned quartz ranging from 8 to 14 inches in width, and, in part, of quartz-lenses contained in a tight shear 18 inches wide. Calcite occurs with the quartz, and patches of heavy sulphides, pyrite, and chalcopyrite occur in the foot-wall. A sample across 14 inches of ribboned quartz containing calcite and a little pyrite assayed: Gold, 0.02 oz. per ton; silver, 0.2 oz. per ton. A bulk sample of the heavy sulphides in the foot-wall assayed: Gold, *nil;* silver, 0.2 oz. per ton. In the crosscut No. 3 vein strikes north 60 degrees west and dips 50 degrees north-east. Where intersected by the crosscut and the winze, the *Sylvanite* vein is a shear-zone which strikes north 25 degrees west and dips 75 degrees north-east. It varies from 2 to 2½ feet in width and consists of sheared greenstone containing lenses of quartz which range from 1 to 8 inches in width, the amount of quartz

varying from 5 to 15 per cent. of the contents of the shear. Pyrite, the only sulphide, is not abundant. A 34-inch sample taken across the shear-zone and including three small lenses of quartz assayed: Gold, 0.62 oz. per ton; silver, 0.4 oz. per ton.

To the south-eastward the nature of the *Sylvanite* vein changes; it becomes stronger and well defined as a continuous band of ribbon-quartz striking north 25 degrees west and dipping 75 degrees north-easterly. It varies from 4 to 8 inches in width and contains some pyrite and pink carbonate. A sample across 8 inches of this material assayed only traces in gold and silver. This portion of the vein has been followed south-easterly for 80 feet from the winze to a point where it is cut by a fault striking north 70 degrees west and dipping 40 degrees northerly. This fault shows a clean hanging-wall, but the foot-wall, 2 feet away, is indefinite. The fault-zone consists of sheared greenstone and occasional fragments of drag-quartz. A 2-inch band of ribbon-quartz in this zone appears to postdate both the *Sylvanite* vein and the faulting.

From a point in the drift 150 feet south-eastward from the crosscut a shear-zone striking north 44 degrees west and dipping 55 degrees north-east continues to the portal. This zone is 2 feet wide and contains a band of ribbon-quartz 6 inches wide, which frequently splits into two or three narrower bands. It may be noted that a region of intensely-crushed rock intervenes between this shear-zone and the one accompanying the *Sylvanite* vein.

The *Yarvi* vein has been intersected by the crosscut at a point 50 feet north-eastward from the drift. It is a shear-zone striking north 45 degrees west and dipping 60 degrees north-east, which varies from 12 to 18 inches in width and consists of one 3-inch band and several small lenses of quartz, in a sheared greenstone matrix. Sulphides are scarce. A sample taken across 14 inches of this material assayed *nil* in gold and silver.

The portal of the 226 adit is 65 feet lower, and 135 feet south 55 degrees east from the south-easterly portal of the *Exploration* adit. It has been driven north 25 degrees west for 200 feet and south 74 degrees west for 40 feet, through badly-crushed ground which has required considerable timbering, to reach faulted portions of vein-matter. From here the working has been continued as more or less of a drift in a direction north 52 degrees west for 70 feet and north 20 degrees west for 55 feet to the winze down from the *Exploration* level. From here the drift has been driven north 35 degrees west for 80 feet to a fault, then south 72 degrees west for 10 feet along the fault, then north 32 degrees west for 30 feet, and north 65 degrees west for 20 feet to the face. A short crosscut was driven north 55 degrees east for 20 feet at a point 20 feet from the face. It is understood that sinking is in progress below the 325 level, cut from the winze 101 feet below the 220 level since the author's examination.

The 226 adit is mostly in badly-disturbed ground and only portions of it explore the probable downward extension of the *Sylvanite* and No. 3 veins. The winze connecting the *Exploration* with the 226 adit was timbered and could not be examined by the writer. On the 226 level the winze is apparently at the junction of two shear-zones, the south-eastward striking north 20 degrees west and dipping 50 degrees north-east, the north-westward striking north 45 degrees west and dipping 65 degrees north-east. Both of these contain broken lenses and stringers of quartz.

South-eastward from the winze the shear, at first ranging from 10 to 18 inches in width and containing two or three 2-inch bands of quartz, becomes tighter and disappears into the south-westerly wall of the adit at a point 70 feet from the winze. Fifteen feet south-eastward from that point the drift intersects a 10-inch shear striking north 70 degrees east and dipping 20 degrees south. This contains two 3-inch bands of quartz and sparse sulphides. Forty feet south-easterly from here, where a short branch has been driven westerly for 10 feet, a disconnected segment of banded quartz lies in a 2-foot shear-zone. The hanging-wall is the more conspicuous wall. It strikes north 55 degrees west and dips 35 degrees north-east. It is to be noted that both the quartz and sheared rock of this occurrence have been definitely cut on the north-west by a strong fault which strikes north 40 degrees east and dips 70 degrees north-west. The flutings in the plane of the fault plunge north-eastward at 70 degrees to the horizontal, indicating that the most recent displacement along the fault-plane has been steeply in this direction. North-westward from the winze the shear, striking north 40 degrees west and dipping 65 degrees north-east, continues as a 2-foot zone of crushed rock containing broken lenses of quartz. A sample across 2 feet of this material assayed: Gold, 0.01 oz. per ton;

1 to 4, on the *H.P.H. No. 2* claim at points 480, 650, 800, and 850 feet east of the adit. Selected samples from Nos. 1, 2, and 3 locations assayed respectively: (1.) Gold, trace; silver, 1.8 oz. per ton; lead, 2.6 per cent.; zinc, 8.3 per cent. (2.) Gold, 0.01 oz. per ton; silver, 14.6 oz. per ton; lead, 20.8 per cent.; zinc, 15.4 per cent. (3.) Gold, trace; silver, 11.8 oz. per ton; lead, 29.1 per cent; zinc, 9.2 per cent. The other showings, number 5 to 11, are at the following points described with reference to the *Lee* adit-portal: No. 5, elevation 710 feet, south 72 degrees west, 231 feet; No. 6, elevation 780 feet, south 53 degrees west, 250 feet; No. 7, elevation 765 to 785 feet, south 65 degrees 30 minutes west, 324 feet; No. 8, elevation 860 feet, south 77 degrees west, 427 feet; No. 9 elevation 890 feet, south 73 degrees west, 1,400 feet; No. 10, elevation 750 feet, south 72 degrees west, 2,060 feet; No. 11, elevation 750 feet, south 73 degrees west, 2,160 feet. Of these the No. 5 showing, where stripping was proceeding, consisted of iron-stained capping irregularly mineralized with sphalerite, occasional galena, and decomposed streaks, being exposed for a width of 3.5 feet along its westerly strike and for 10 feet on its dip of from 40 to 45 degrees to the north. Apparently part of a more extensive capping, the mineralization seemed to follow the foot-wall of a dyke of altered rhyolite or trachyte, a dense greyish silicified rock containing much pyrite. A selected sample here assayed: Gold, trace; silver, 1 oz. per ton; lead, *nil;* zinc, 19 per cent. Selected samples from Nos. 6 and 7 locations assayed respectively: Gold, 0.01 oz. per ton; silver, 32.8 oz. per ton; lead, 22.2 per cent.; zinc, 7.6 per cent.; and: Gold, 0.01 oz. per ton; silver, 3.8 oz. per ton; lead, 1.1 per cent.; zinc, 14.5 per cent.

The southern zone, in which mineralization is naturally exposed or has been found at widely separated points on the *H.P.H. No. 6* and *Pendic No. 18* claims, lies on the undulating ground draining to Idas (Canyon) Creek south-west of the *Lee* adit and south of the main ridge. These showings, numbered 12 to 15, are described with reference to the *Lee* adit-portal as follows: No. 12, elevation 725 feet, south 54 degrees west, 1,500 feet; No. 13, elevation 770 feet, south 55 degrees west, 2,130 feet; No. 14, elevation, 1,000 feet, south 67 degrees 30 minutes west, 3,150 feet; No. 15, elevation 725 feet, south 72 degrees 30 minutes west, 3,000 feet. Of these the showing at No. 13 location is an exposure 4 by 5 feet, covered around the edges, being part of a strong oxidized capping containing streaks and bunches of sphalerite, with some molybdic oxide as a yellow incrustation. A selected sample assayed: Gold, 0.04 oz. per ton; silver, 12.2 oz. per ton; zinc, 7.2 per cent. A selected sample from No. 14 location assayed: Gold, trace; silver, 29.8 oz. per ton; lead, 7.9 per cent.; zinc, 20.3 per cent. No. 15 showing, apparently part of an extensive capping, consists of several widely-separated patches of oxidized, silicified limestone containing streaks of sulphides and seams of decomposed material. A selected sample assayed: Gold, 0.01 oz. per ton; silver, 17.4 oz. per ton; lead, 26.4 per cent.; zinc, 7.9 per cent.

Summarizing conditions on the *H.P.H.* property, the various partial and incomplete exposures include promising objectives for development.

Evidence of definite structural control of mineralization is lacking at the present stage of exploration. In regard to the major objective, or the largest body exposed in and adjacent to the two shafts, there is evidence that, though irregular in outline, cross-section, and intensity of mineralization, it has an approximately tabular or pipe-shaped form pitching somewhat flatly to the west or south-west. This is indicated by the mineralization along the western or north-western wall of the cave, which was penetrated farther than had been done before. The adit and adjacent workings have disproved continuity in other respects. In this connection an interesting discussion regarding the origin and form of the *H.P.H.* deposits is contained in Gunning's report previously mentioned. Taking into consideration the present lack of transportation facilities and the economics of silver-lead-zinc production, conditions call for larger tonnage of better-grade and more regular ore than if the property was more cheaply accessible.

North Shore.—A limited amount of prospecting on this group of claims has disclosed irregularly-silicified limestone containing scattered streaks and patches of sphalerite mineralization, with minor amounts of galena, at several widely-separated points along the steep, densely-wooded slope to Nahwitti Lake at 575 feet elevation.

Two indefinite showings, at elevations of 625 and 775 feet, were examined in cuts near the western boundary of the claims east of Nahwitti River and just east of an area of hornblende latite. A selected sample from the upper point assayed: Gold, trace; silver, 6 oz. per ton; lead, 1.3 per cent.; zinc, 13.6 per cent. Another cut in this vicinity, at 725 feet elevation, exposes contact-metamorphic mineralization, consisting of magnetite and cupriferous pyrite,

major exposure of which lies some 1,500 or 2,000 feet southerly and equidistant from the vein system, which strikes north 70 degrees east, with south-easterly dips of from 50 to 65 degrees. Across the valley the batholithic rocks are again exposed on the southern and south-eastern slopes of Mount Truax. The vein-fissures are very persistent, cutting all rocks and included dykes encountered by them in the area of Bridge River series, with little perceptible difference in the strength of fissuring in specific rock-types. Mineralization in the quartz gangue consists of stibnite, which is widely distributed in disseminations, streaks, and masses, with smaller amounts of pyrite, grey copper (chiefly tennantite?), sphalerite, galena, and arsenopyrite. Two polished sections, examined under the microscope, gave the following information: (1.) Composed of disseminated irregular masses of stibnite in a quartzose gangue. Minor amounts of sphalerite, pyrite, and arsenopyrite were noted, both alone and in intimate asociation with stibnite. (2.) Composed of small irregularly disseminated masses of tennantite (?), commonly in close association with minor amounts of sphalerite, arsenopyrite, and pyrite. In places covellite veins the tennantite (?). Only a few grains of stibnite were noted in this section. Realgar is comparatively well developed in places. High silver values are associated with the grey copper, which is fairly abundant in some areas. Gold values, in the writer's channel samples, vary from a trace to 0.06 oz. per ton and from 0.01 to 0.12 oz. per ton in selected material. Massive stibnite occurrences, lacking other sulphides, contain no appreciable gold or silver. Vein-widths vary from a few inches to 7 feet or more, average widths of from 3 to 4 feet being indicated in several sections. Mineralization is extensive, and stibnite, nearly always present, forms a considerable proportion of the vein-filling in some localities. Oxidation is shallow or local, the unaltered sulphides being generally exposed.

The claims were staked by Andy Bergenham in 1931, the property being acquired by the Gray Rock Mining Syndicate in the autumn of 1936. Subsequently new camp accommodation was provided and preparations were made for development.

Workings are limited to comparatively few shallow cuts and trenches, but the outcrops of the six (or more) veins are naturally exposed at many points on precipitous bare ground. Some long sections stand out prominently in bluffs, dangerous of access without proper equipment. The *No. 1* vein is the best exposed, its continuity being traceable over a length of between 5,000 and 6,000 feet. The following description of surface conditions is largely based on pace and compass-work and the writer is indebted for part of these data to E. H. Lovitt, measurements supplied being corroborated and extended. The number of samples taken by the writer was necessarily restricted and in order to define the zones of concentrated mineralization, or shoots, a large sampling operation preceded by much trenching and stripping would be necessary.

Twelve of the fourteen claims are staked in a block, four claims long by three claims wide, with the principal or *No. 1* vein striking north 70 degrees east lengthwise through the middle of the block—namely, from east to west, along the centre line of the *Eastman, Gray Rock No. 1, Gray Rock No. 5*, and *Gray Rock No. 8* claims. Surface showings examined include those on the *Nos. 1–5* veins and the *Westman* vein. The zero, or point A, adopted for descriptive purposes is on the western edge of a rock-slide at 6,570 feet elevation at the theoretical intersection (covered) of the *No. 1* vein with the boundary between the *Eastman* and *Gray Rock No. 1* claims. Measuring easterly from point A, this vein was traced up the bluffs and diagonally along the steep ground by natural exposures and occasional shallow cuts from the eastern side of the rock-slide at chainage 100 feet, elevation 6,600 feet, to chainage 700 feet, at elevation 6,880 feet, where it cuts a large granite dyke. The same vein is reported to be traceable for a further 1,000 feet easterly beyond the dyke to an elevation of about 7,700 feet. Reverting to the 600-foot length examined, the vein is generally split into two sections which are from 12 to 6 feet apart. The following three samples were taken along the northern vein split, which is the more easily followed of the two: A sample across 1 foot, at 6,600 feet elevation, assayed: Gold, 0.01 oz. per ton; silver, 6.2 oz. per ton. At 6,650 feet elevation a sample across 6 inches, on the foot-wall side of the 2-foot total width, assayed: Gold, 0.06 oz. per ton; silver, 21.8 oz. per ton; lead, 18 per cent. At 6,880 feet elevation, where the vein cuts the dyke, a sample across 9 inches assayed: Gold, 0.01 oz. per ton; silver, 1 oz. per ton. There were streaks of stibnite at the last two points, these samples not being assayed for antimony. The southern vein-split is narrow where exposed at rare intervals, mineralization being similar. Going westerly from point A, this *No. 1* vein is covered by talus to chainage

150 feet, from which point it is well exposed by closely-spaced trenches, along the general contour of the slope at about 6,800 feet elevation, to chainage 280 feet, where it is deeply covered by another rock-slide. Samples taken in this 130-foot length, which averages 4 feet in width, gave the following results:—

Chainage in Feet.	Width in Feet.	Gold.	Silver.	Antimony.
		Oz. per Ton.	Oz. per Ton.	Per Cent.
150	1.5	Trace	0.6	*Nil*
168	2.5	0.02	26.2	0.5
187	3.3	0.01	5.2	1.0
193	4.0	0.01	10.2	2.9
202	5.0	0.01	1.6	4.9
218	3.0	Trace	0.6	1.0
227	4.5	0.01	15.2	0.9
232	5.0	0.04	76.8	5.0
236	6.0	Trace	3.6	9.0
259	6.0	0.01	4.0	1.0
280	3.0	0.01	0.4	*Nil*

Continuing westerly, the vein is covered by the rock-slide between chainages 280 and 403 feet. Where it reappears at the latter point the vein is offset about 20 feet to the north, presumably by a fault between the points specified. A well-mineralized section, exposed by trenching between chainages 403 and 445, averages 3.8 feet in width and was sampled as follows:—

Chainage in Feet.	Width in Feet.	Gold.	Silver.	Antimony.	Lead.	Zinc.
		Oz. per Ton.	Oz. per Ton.	Per Cent.	Per Cent.	Per Cent.
403	4.0	Trace	2.0	14.1	.....	.....
423	4.5	0.06	82.8	9.0	6.0	8.0
429	5.5	0.02	60.4	12.0	.....	.....
436	3.8*	0.02	4.2	2.5	.....	.....
436	2.6†	0.05	42.0	6.6	.....	.....
445	2.4	0.01	30.0	2.4	.....	.....

* Foot-wall. † Hanging-wall.

The sample at chainage 423 feet was also assayed for copper, the content being 0.5 per cent. Where blanks occur in the lead and zinc columns no assay was made for these metals, which may be present in minor amounts.

Continuing up the steeply-ascending ground westerly from chainage 445 feet, the vein is generally well exposed by trenches and natural outcrops to chainage 620 feet, throughout which length the quartz, averaging about 4 feet in width, is lightly mineralized with sulphide-streaks, stibnite predominating. From the latter point westerly up the edge of the bluffs to chainage 706 the vein, apparently narrow, is poorly exposed. Between chainages 706 and 720 feet there is a 14-foot length, of an average width of 4 feet, in which a sample across 4.6 feet, at chainage 715 feet, assayed: Gold, 0.02 oz. per ton; silver, 0.2 oz. per ton; antimony, 5 per cent. This section was made up of widths of 1.8 feet of quartz with sulphide-streaks against the hanging-wall, 2.6 feet of rusty quartz and oxidized siliceous gangue in the central part, and oxidized decomposed material with sulphide-streaks 0.2 feet wide next to the foot-wall. The 720-foot point, at 6,950 feet elevation, is on the eastern edge of a precipitous canyon. West of this point conditions are dangerous without proper equipment. Selected samples from the vein imperfectly exposed but apparently quite wide locally, were taken on a ledge at chainages 770 and 790 feet. These assayed respectively: Gold, trace; silver, 0.2 oz. per ton; antimony, 6 per cent.; and: Gold, 0.01 oz. per ton; silver, trace; antimony, 3 per cent. Realgar specimens were also obtained from this vicinity. West of chainage 790 feet the outcrop stands out boldly, climbing along the precipitous bluffs to an ultimate elevation approximating 8,000 feet. *Beyond the dangerous ground between chainages 770 and 1,156 feet the outcrop can be followed* easterly down from the summit. Between the latter point and chainage 1,358 feet accessible vein-exposures, containing light sulphide mineralization, are from 2.5 to 7 feet wide, and

westerly to chainage 1,471 feet the vein, more continuously exposed, averages about 2.5 feet in width, the generally similar mineralization, in which stibnite predominates, including occasional streaks of grey copper. The above showings, west of initial point A, are on the *Gray Rock No. 1* claim. Continuing westerly, the ground falls steeply to the *Gray Rock No. 5* claim, through which the vein-continuity is traced or indicated by outcrops, sometimes widely separated owing to rock-slides or ice ridges, over the irregular ground on to a ridge at the western end of the property on the *Gray Rock No. 8* claim, possibly 1 mile from point A. Measurements are not available west of those previously specified, two samples being taken for information, at 7,260 feet elevation and on the *Gray Rock No. 5* claim, just west of an extensive rock-slide, east of which the vein-outcrop stands out prominently where it climbs the bluffs to the summit on the *Gray Rock No. 1* claim. The vein here, split into two sections 6 feet apart, is exposed for a 20-foot length. A sample across the northern section, 1 foot wide, assayed: Gold, 0.02 oz. per ton; silver, 2.6 oz. per ton; copper, *nil;* lead, 2.7 per cent.; and a sample across the southern section, 8 inches wide, assayed: Gold, 0.02 oz. per ton; silver, 35.4 oz. per ton; copper, 0.3 per cent.; antimony, 0.5 per cent. Immediately west of this showing the ground falls steeply to a rock-slide at 7,000 feet elevation, then the vein-fractures reappear where they cut through a rocky hump in a glacier at about 800 feet west of the showing sampled. Vein-outcrops are again exposed on a ridge 2,000 feet, roughly estimated, farther west.

Of the other veins, *No. 2*, which generally has a comparatively heavy stibnite content, is the best exposed. Point B, adopted for description, is the theoretical intersection of the *No. 2* vein with the boundary between the *Eastman* and *Gray Rock No. 1* claims, or about 100 feet southerly from point A. About 600 feet easterly from point B this vein is partially exposed by a shallow cut, at about 6,930 feet elevation, where there is a showing of quartz and oxidized material 2.5 feet wide, including a 5-inch streak on the foot-wall side, which assayed: Gold, 0.01 oz. per ton; silver, trace; antimony, 16 per cent.; arsenic, *nil*. At this point the *Nos. 1* and *2* veins are about 60 feet apart, having converged in this section. Measuring westerly from point B, the *No. 2* vein, at 6,850 feet elevation, is exposed from chainages 189 to 280 feet between two rock-slides. From chainage 189 to 244 feet partial outcrops indicate the continuity of this vein. Between the latter point and chainage 280 feet three samples were taken. The first, across 2 feet at chainage 244 feet, assayed: Gold, trace; silver, trace. Light stibnite mineralization is present in the quartz here. The next sample, across 2.3 feet at chainage 264 feet, assayed: Gold, trace; silver, trace; antimony, 15 per cent. The third, across 2.5 feet at chainage 276 feet, assayed: Gold, trace; silver, trace; antimony, 17 per cent. Beyond the western rock-slide the outcrop is almost continuously exposed up the bare, steep slope between chainages 405 and 720 feet, the latter point, on the eastern edge of the precipice at elevation 7,040 feet, being the western limit reached by the writer. Good specimens of realgar were obtained at some risk by Andy Bergenham just west of chainage 720 feet. Throughout the section examined, the vein, well mineralized with stibnite, is locally oxidized at the highest point specified, where a selected sample assayed: Gold, 0.12 oz. per ton; silver, 0.2 oz. per ton. On the bluff, 8 feet above this imperfectly-exposed oxidized showing, there is a parallel vein or split, 3 to 9 inches wide, containing streaks of realgar and stibnite. Twelve feet easterly, at elevation 7,015 feet, a partial exposure, 15 inches wide, assayed: Gold, 0.02 oz. per ton; silver, 8.6 oz. per ton; antimony, 17 per cent.; arsenic, *nil*. Oxidized material on the foot-wall side indicates greater width than the section sampled.

The *No. 3* vein, approximately 2 feet wide, is partially exposed between chainage-points 300 and 450 feet west of point C, which is about 200 feet southerly from point B and on the same claim boundary-line at a higher elevation. A selected sample assayed: Gold, 0.02 oz. per ton; silver, trace; antimony, 35 per cent.; arsenic, 0.1 per cent. At a still higher elevation the *No. 5* vein, apparently from 8 inches to 2 feet wide, is exposed by outcrops at intervals for a length of about 400 feet between chainage-points 50 feet east and 350 feet west of point D, which is approximately 100 feet southerly from point C and on the same claim boundary. Selected samples were taken at (*a*) 200 feet west and (*b*) 350 feet west of point D. These assayed respectively: Gold, 0.04 oz. per ton; silver, 53.4 oz. per ton; antimony, 1.1 per cent.; and: Gold, 0.03 oz. per ton; silver, 23.2 oz. per ton; antimony, 14 per cent.; arsenic, *nil*.

At 7,080 feet elevation, crossing a ridge between rock-slides near the north-east corner of *Gray Rock No. 5* claim, the *No. 4* vein can be traced by outcrops for a length of 150 feet, where

it is mostly from 6 to 8 inches wide but swells at the western end to 2.5 feet. A selected sample assayed: Gold, 0.03 oz. per ton; silver, 0.4 oz. per ton; antimony, 10.9 per cent. This *No. 4* vein is 300 feet, roughly estimated, to the north of the *No. 1* vein. The *Westman* vein, exposed on the *Gray Rock No. 6* claim, which adjoins the *Gray Rock No. 1* to the north, is the lowest and farthest north of the series. It is exposed by outcrops and three open-cuts for a length of 400 feet or more along the 6,640-foot contour of the precipitous ground overlooking Truax Creek from the south. The showings consist of iron-stained quartz and oxidized siliceous gangue containing light sulphide mineralization without any appreciable amount of stibnite. A sample across 1 foot in the western cut assayed: Gold, 0.04 oz. per ton; silver, 4 oz. per ton; and a sample across 10 inches in a cut 150 feet to the east assayed: Gold, 0.02 oz. per ton; silver, 0.4 oz. per ton. In the third cut, 60 feet farther east, there are quartz stringers along well-marked fracturing in sheared, silicified, iron-stained rock. Two hundred feet farther east the vein, traced by outcrops throughout the interval, consists of a zone of quartz bands and stringers 8 feet wide.

Summarizing conditions, the veins occupy well-defined fissures and are remarkably persistent in lateral extent, appreciable continuity in depth being already indicated by the unequal erosion. The antimony content is of interest if, at a more advanced stage of development, it can be shown that a clean stibnite concentrate can be made. Grey-copper mineralization is sufficiently continuous in places to warrant the assumption that good average silver values exist in some vein areas. Gold values, not important in present exposures, may become of accessory value. No evidence is yet available of a possible change in the character of the mineralization at depth, the same minerals being exposed in deeply-eroded sections as at the higher elevations. The presence of arsenopyrite, as detected in the thin sections, is of considerable interest, this mineral usually being auriferous in the Bridge River District. The general tendency, in connection with deposits containing stibnite and arsenopyrite, is for decreasing amounts of the former mineral as depth is attained, with an increase in the proportion of the latter.

SILVER-LEAD-ZINC DEPOSITS.

Nahwitti Lake Area.

H.P.H., North Shore, South Shore.

The nucleus of the *H.P.H.* property consists of six claims known as the *H.P.H. Nos. 1, 2, 3, 6, 8,* and *Idas*, held by location and owned by S. S. Pugh and M. Hepler, the original discoverers, both of Port Hardy. In June, 1936, these claims were under option to W. G. Dickinson, who, with associates of Victoria, had acquired, by staking, eighteen additional contiguous claims. The *South Shore* group consists of ten claims held by location, three of which, owned by M. Hepler and F. Hicklenton, were included in the option, the other seven claims having been staked by the Victoria interests, who had also staked five claims known as the *North Shore* group. The *H.P.H.* camp and main workings, 14.25 miles westerly from Port Hardy, are situated about 6,000 feet easterly from the east end of Nahwitti Lake (*see* B.C. Lands Department Map No. 2c, entitled " Northerly Portion of Vancouver Island "). The *North Shore* and *South Shore* groups are located along the northern and southern sides respectively of Nahwitti Lake adjacent to its western end. All three prospects are in the Quatsino Mining Division.

The principal showings on the *H.P.H.* property are on the steep north slope of the ridge which forms the southern side of the Upper Nahwitti River Valley. This small stream flows westerly into Nahwitti Lake through swampy flats the elevation of which, at a point opposite the camp and main workings, is about 600 feet. Elevations in the prospected area to the south of the valley are up to 1,050 feet, this elevation representing the highest point on the summit of the ridge, which continues for some miles to the east and west. Showings on the *North Shore* and *South Shore* groups, at elevations up to 1,040 feet, are on the steep slopes to Nahwitti Lake, which is at about 575 feet elevation. The whole area is well timbered with hemlock, cedar, and balsam, trees being up to 6 feet in diameter, hemlock predominating. The area comprising the *H.P.H.* property contains small creeks flowing steeply to the main stream, such as Idas (Canyon) Creek, which affords possibilities for the development of a small water-power. There are also small creeks flowing into the lake on the *South Shore* ground. The *North Shore* prospect is just east of Nahwitti River where it flows out of the lake.

Access is from Port Hardy on the east coast of Vancouver Island, first for 1 mile along the road towards Coal Harbour, on Quatsino Sound, then westerly by trail 9 miles in length to

the eastern end of Kains Lake. A rowboat is then used for 2.5 miles to reach the western end of this lake. From this point the trail continues westerly for a length of 5 miles to the *H.P.H.* camp, the total distance from Port Hardy being about 17.5 miles. The trail, starting just above sea-level at the road west of Port Hardy, climbs to an elevation of 1,000 feet at Kains Lake, and the remaining section, after reaching a maximum elevation of 1,100 feet west of this lake, descends to the *H.P.H.* camp at 620 feet elevation. The trail sections traverse a densely wooded or timbered district in which swampy areas abound. The going is rough and pack-horses could not be used without extensive trail improvements, including construction of long stretches of corduroy. When development was in progress in the autumn of 1930 and following winter months, supplies and equipment were largely brought in by plane to Kains Lake, from which point men packed them to the property. Nahwitti Lake, which is much nearer, also affords good landing facilities for a plane.

A much shorter trail-location, possibly about 8 miles in length, could be located south-easterly and southerly from the *H.P.H.* camp over a low pass at 850 feet elevation to a point on the West Arm of Quatsino Sound some 6 or 7 miles west of Coal Harbour. Nahwitti Lake is about 4,000 feet wide and 2.2 miles in length and the *H.P.H.* property is connected with it by trail, the *North Shore* and *South Shore* prospects being reached by rowboat.

The general geology surrounding the *H.P.H.* deposits is described by H. C. Gunning in Geological Survey of Canada Summary Report, Part A, 1931, page 37-A. Extending this to include neighbouring prospects, silver-lead-zinc replacements have been found at intervals over a total length of 4.6 miles in an east-west direction (including the *Dorlon* group, described separately). The showings occur in bands of grey to black fine-grained limestone, frequently silicified. Limestone areas in the *H.P.H.* section have been prospected over a length of 4,500 feet and a width up to 1,700 feet. The principal limestone-band, to which the foregoing report applies, has been estimated to be at least 500 feet thick. It strikes a little north of west and dips to the south at from 35 degrees or less to 65 degrees. The base of this limestone is not exposed, but according to Gunning it probably contacts with the underlying volcanic flows and fragmentals in the drift-covered flats immediately north of the ridge. Near and south of the top of the ridge the limestone is interbedded with and overlain by siliceous grey tuffs, felsite, hornblende andesite, and hornblende andesite porphyry. Farther south, or at points from one-half to three-quarters of a mile south of the flats, the aforementioned rocks are intruded by a large body of granodiorite or diorite. A specimen representing a local phase of this intrusive is a fine-grained, light-coloured phanerocrystalline rock, determined microscopically as hornblende granodiorite, the approximate mineral composition being: Orthoclase, 20 per cent.; combined albite and oligoclase, 20 per cent.; quartz, 50 per cent.; with some accessory iron ore, chlorite, and epidote present. There are a few sills, dykes, and irregular bodies of aplite, felsite, and altered rhyolite or trachyte in the limestone, also occasional dykes of augite andesite and augite andesite porphyry. The above conditions apply to the *H.P.H.* section. On the ground comprising the *North Shore* and *South Shore* groups the limestone-bands, interbedded with acid and basic volcanics, shales, and tuffs, are comparatively narrow and outcrop over a smaller areal extent. Basic volcanics, which interrupt the continuity of the *North Shore* limestone, include hornblende latite and similar rocks are exposed along the southern side of the lake between the *South Shore* limestone and the water. To the south, and on the steep slope about 400 feet above the lake, this limestone is overlain by shales, tuffs, and felsites. Included in the series an extrusive type noted has been completely altered to yellowish-brown carbonate. Cutting shale near one showing there is a small dyke of grey fine-grained rock containing numerous specks of pyrite. Granodiorite, probably connected with the large intrusive body observed to the south of the *H.P.H.* group, outcrops at numerous points roughly parallel to the north and south sides of Nahwitti Lake at from 2,000 to 3,500 feet away, these main branches connecting at points half a mile or less west of the western end of the lake. At the western end of the *South Shore* property the limestone is directly underlain by granodiorite. In the vicinity of the showings on the same group the limestone is cut by a dyke, 50 feet wide or more, of hornblende diorite, a fine- to medium-grained greenish rock, a specimen of which was composed of andesine 50 per cent. and hornblende 40 per cent., with accessory iron ore, rutile, apatite, and quartz.

The prevailing type of mineralization, occurring as irregular replacements lacking definite structural boundaries, consists of galena and sphalerite in a gangue of black, fine-grained,

silicified limestone, or of dark-grey limestone. In some phases a crustified or cellular quartz gangue has been developed and in others the limestone is leached. The sulphides are generally exposed at or near the surface, oxidation, where present, being local or shallow. Some oxidized cappings containing sulphide remnants have only been partially exposed by stripping. The presence of small amounts of pyrite, pyrrhotite, and chalcopyrite has been reported in some specimens of silver-lead-zinc ore from the *H.P.H.* The mineralization varies from material, generally siliceous, through which the lead and zinc sulphides occur as disseminations or streaks, to nearly clean galena or galena and sphalerite masses. The silver values fluctuate considerably. Twelve samples from the *H.P.H.* group show a silver ratio of from ½ to 3¾ oz. to the unit of lead, the average being 1.4 oz. Sphalerite predominates at the *North Shore* and *South Shore* prospects and silver values are low. Gold values in all samples varied from a trace to 0.04 oz. to the ton, the average content being negligible. Several undeveloped exposures of magnetite have been reported to occur on the *H.P.H.* group, but these were not visited. Gunning refers to a showing at the south-west corner of the original group, about 1 mile from the cabins, as an extensive development of garnet and epidote, with some magnetite, minor pyrrhotite, pyrite, and occasional arsenopyrite, lying against granodiorite, no work having been done at that point.

The original claims constituting the *H.P.H.* property were staked in 1930. Subsequently an option was acquired on the group by the American Smelting and Refining Company, with the result that a limited amount of exploratory work was done in the winter of 1930–31. The company ceased work in the spring of 1931 and relinquished its option. The property then lay idle until early in 1936, when an option was taken by the Victoria interest previously mentioned and small-scale development continued.

The claims constituting the *North Shore* and *South Shore* groups are recent stakings. Specific conditions on the three prospects are separately described as follows:—

H.P.H.—Locally the limestone is considerably jointed, most of the joints being at about right angles to the strike of the formation. In the vicinity of the principal workings there are numerous irregular and discontinuous fractures. Evidence of definite structural control is at present lacking, the mineralization occurring in irregular patches or lenticular zones. The largest showing is exposed or indicated by stripping and trenching for a length of 125 feet or more and a width of from a few inches to about 12 feet.

Exclusive of this comparatively large body, around which most of the development-work has been done, silver-lead-zinc mineralization has been exposed at fifteen separate points on five claims, the *H.P.H. Nos. 1, 2, 3,* and *6,* and *Pendic No. 18,* which form a block in the centre of the staked area. The principal showings, first referred to, are on the steep, "bluffy" ground forming the toe of the ridge just south of the flats at 600 feet elevation. Surface workings here consist of stripping and trenching. Those exposing mineralization are enclosed within an area 260 feet long measured easterly-westerly and about 42 feet wide between the 620- and 660-foot contours. The general trend of the mineralization is westerly, but this turns a little south of west towards the western end of the exposures. Chaining in feet from east to west conditions are as follows: From zero to 32, two parallel narrow zones of iron-stained capping containing sulphide-streaks and seams of decomposed oxidized material; from 32 to 70, limestone covered in part with moss and soil; from 70 to 92, strong lead-zinc mineralization from a few inches to 3 feet in width; 92 to 97, covered; 97 to 164, continuous irregularly-shaped meandering exposure of massive sulphides from 1 to 12 feet in width, plus adjoining small lenses to the north separated from the main body by unreplaced limestone; 164 to 188, iron-stained silicified limestone irregularly mineralized over a width up to 8 feet with scattered streaks and bunches of sulphides; from 188 to 208, covered; 208 to 214, trench exposing a width of 18 feet of oxidized capping and soil; 214 to 256, covered; and from 256 to 260, trench exposing width of 6 feet of oxidized capping and soil. Just west of here, at chainage 271 feet, a long trench is in soil, some mineralized float being found in it. Reverting to the area of the massive and continuous mineralization between chainage-points 97 and 164, the collar of the east shaft is at chainage 109 and 660 feet elevation. This shaft, 12.5 feet deep to the water-level, is first sunk 8 feet as a steep incline to the south and then vertical. A short crosscut said to be 8 feet long extends to the west from the shaft-bottom, but this was inaccessible. On the east side of the shaft massive sulphides are exposed over a thickness, measured down from the collar, of 6 feet, and a sample across this width assayed: Gold, 0.02 oz. per ton; silver, 35.2 oz.

per ton; lead, 41 per cent.; zinc, 25.7 per cent. Selected galena from the same place assayed: Gold, 0.01 oz. per ton; silver, 106.4 oz. per ton; lead, 78.5 per cent.; and selected sphalerite assayed: Gold, 0.01 oz. per ton; silver, 12.4 oz. per ton; zinc, 49.9 per cent. Massive sulphides, but containing less galena, are exposed down the west side of the shaft for 8 feet below the collar. It was not practicable to inspect the shaft below these workings due to the rotten condition of the ladder, and water. It is reported on good authority that mineralization persisted to some extent to the bottom of the shaft where the ore-width was reduced to 6 inches. The west shaft, at chainage 165 feet and about 648 feet elevation, is distant 56 feet on a bearing of north 62 degrees west from the collar of the east shaft. It was sunk vertically for the first 12 feet, but the lower part of this section has filled in so that for practical purposes the west shaft is now an incline sunk to south 32 degrees west for 28.5 feet on a 57-degree slope, attaining a depth of 24 feet below the collar. At this point it was driven into a cave in the limestone which extends south 60 degrees west for 30 feet to Station A, thence south 36 degrees west for 6 feet to Station B, and finally for 22 feet due west through a low gallery, difficult of access, to a pot-hole containing deep water at Station C. The cave descends gently to a level about 6 feet below the bottom of the shaft or 30 feet below the collar. From Station B a branch gallery 4 feet long leads south-westerly to another and larger water-filled hole. The cave has been formed along irregular fractures with variable strikes and dips. The shaft is first sunk in a zone, up to 8 feet wide on the surface, of light mineralization consisting of irregular streaks and disseminations of sulphides in iron-stained silicified limestone. Similar conditions are apparent for 12 feet down the shaft. From this point the sulphide mineralization continues chiefly along the western side of the shaft and north-western and western side of the cave, as stringers and scattered pockets, or patches lining the cave-walls. The most continuous mineralization of the last-mentioned type is exposed on the western wall of the cave opposite Stations A and B. This showing, 10 feet long and 10 feet high, is associated with a vertical fracture striking south 30 degrees west. Galena predominates here and a selected sample assayed: Gold, 0.02 oz. per ton; silver, 81.8 oz. per ton; lead, 55.5 per cent.; zinc, 15.7 per cent. Selected material from the farthest-west point reached in the cave assayed: Gold, 0.04 oz. per ton; silver, 17.4 oz. per ton; lead, 11.9 per cent.; zinc, 20.6 per cent. Similar mineralization, occurring as scattered streaks at numerous points along the northern wall of the cave between Stations B and C, is associated with a fracture striking due west with variable dips to the north. The restricted dimensions of the latter passage prevented thorough inspection of conditions, but it would appear that the cave generally follows along the southern margin of the mineralized zone traced on the surface, gaining depth on it going south-west.

From a point 60 feet north 7 degrees east from the collar of the east shaft and 50 feet below it, at 610 feet elevation, the *Lee* adit has been driven 111 feet along a bearing of south 17 degrees west, so that it passes under the ground between the two shafts. Chaining in feet from the portal, solid rock was reached at 26; from 26 to 45 the adit cuts altered grey to green siliceous rock containing garnet, epidote, scattered specks of pyrrhotite, pyrite, and rarely chalcopyrite; at 45 feet this rock contacts irregularly with grey limestone dipping from 30 to 45 degrees to the south; from 45 feet to the face the adit is all in limestone. At 98 feet in from the portal a branch working 10 feet long has been driven north 60 degrees west at a point where some galena and sphalerite mineralization, associated with local silicification, is exposed in the back of the main adit. This stringer, up to 14 inches wide, pitches westerly at about 30 degrees into the floor of the branch working. Fifteen other scattered silver-lead-zinc showings were examined, but it is not practicable to describe them all separately in this report. Only a small amount of work, consisting of stripping and shallow cuts, had been done on them, so that little evidence is afforded of the continuity, form, or extent of the mineralization. The sulphides, irregularly distributed through the limestone, generally where it is silicified, occur in some cases as remnants in oxidized cappings. All the showings trend westerly or south-westerly, dips where indicated being generally to the south or south-east into the hill. In two cases, however, dips to the north were noted. No definite structure was observed, discoveries having been made at various horizons in the limestone. These can be roughly segregated into two broad zones, most of the prospecting having been done on the northern one, which includes the previously described *Lee* adit area. This zone, traversing the *H.P.H. Nos. 2, 1, and 3* claims from east to west along the steep, northerly slope to the flats, lies north of and roughly parallel to a dyke or sill of augite andesite, up to 20 feet wide or more, which passes 438 feet south of the *Lee* adit-portal. In this belt there are four showings, numbered for convenience

1 to 4, on the *H.P.H. No. 2* claim at points 480, 650, 800, and 850 feet east of the adit. Selected samples from Nos. 1, 2, and 3 locations assayed respectively: (1.) Gold, trace; silver, 1.8 oz. per ton; lead, 2.6 per cent.; zinc, 8.3 per cent. (2.) Gold, 0.01 oz. per ton; silver, 14.6 oz. per ton; lead, 20.8 per cent.; zinc, 15.4 per cent. (3.) Gold, trace; silver, 11.8 oz. per ton; lead, 29.1 per cent; zinc, 9.2 per cent. The other showings, number 5 to 11, are at the following points described with reference to the *Lee* adit-portal: No. 5, elevation 710 feet, south 72 degrees west, 231 feet; No. 6, elevation 780 feet, south 53 degrees west, 250 feet; No. 7, elevation 765 to 785 feet, south 65 degrees 30 minutes west, 324 feet; No. 8, elevation 860 feet, south 77 degrees west, 427 feet; No. 9 elevation 890 feet, south 73 degrees west, 1,400 feet; No. 10, elevation 750 feet, south 72 degrees west, 2,060 feet; No. 11, elevation 750 feet, south 73 degrees west, 2,160 feet. Of these the No. 5 showing, where stripping was proceeding, consisted of iron-stained capping irregularly mineralized with sphalerite, occasional galena, and decomposed streaks, being exposed for a width of 3.5 feet along its westerly strike and for 10 feet on its dip of from 40 to 45 degrees to the north. Apparently part of a more extensive capping, the mineralization seemed to follow the foot-wall of a dyke of altered rhyolite or trachyte, a dense greyish silicified rock containing much pyrite. A selected sample here assayed: Gold, trace; silver, 1 oz. per ton; lead, *nil;* zinc, 19 per cent. Selected samples from Nos. 6 and 7 locations assayed respectively: Gold, 0.01 oz. per ton; silver, 32.8 oz. per ton; lead, 22.2 per cent.; zinc, 7.6 per cent.; and: Gold, 0.01 oz. per ton; silver, 3.8 oz. per ton; lead, 1.1 per cent.; zinc, 14.5 per cent.

The southern zone, in which mineralization is naturally exposed or has been found at widely separated points on the *H.P.H. No. 6* and *Pendic No. 18* claims, lies on the undulating ground draining to Idas (Canyon) Creek south-west of the *Lee* adit and south of the main ridge. These showings, numbered 12 to 15, are described with reference to the *Lee* adit-portal as follows: No. 12, elevation 725 feet, south 54 degrees west, 1,500 feet; No. 13, elevation 770 feet, south 55 degrees west, 2,130 feet; No. 14, elevation, 1,000 feet, south 67 degrees 30 minutes west, 3,150 feet; No. 15, elevation 725 feet, south 72 degrees 30 minutes west, 3,000 feet. Of these the showing at No. 13 location is an exposure 4 by 5 feet, covered around the edges, being part of a strong oxidized capping containing streaks and bunches of sphalerite, with some molybdic oxide as a yellow incrustation. A selected sample assayed: Gold, 0.04 oz. per ton; silver, 12.2 oz. per ton; zinc, 7.2 per cent. A selected sample from No. 14 location assayed: Gold, trace; silver, 29.8 oz. per ton; lead, 7.9 per cent.; zinc, 20.3 per cent. No. 15 showing, apparently part of an extensive capping, consists of several widely-separated patches of oxidized, silicified limestone containing streaks of sulphides and seams of decomposed material. A selected sample assayed: Gold, 0.01 oz. per ton; silver, 17.4 oz. per ton; lead, 26.4 per cent.; zinc, 7.9 per cent.

Summarizing conditions on the *H.P.H.* property, the various partial and incomplete exposures include promising objectives for development.

Evidence of definite structural control of mineralization is lacking at the present stage of exploration. In regard to the major objective, or the largest body exposed in and adjacent to the two shafts, there is evidence that, though irregular in outline, cross-section, and intensity of mineralization, it has an approximately tabular or pipe-shaped form pitching somewhat flatly to the west or south-west. This is indicated by the mineralization along the western or north-western wall of the cave, which was penetrated farther than had been done before. The adit and adjacent workings have disproved continuity in other respects. In this connection an interesting discussion regarding the origin and form of the *H.P.H.* deposits is contained in Gunning's report previously mentioned. Taking into consideration the present lack of transportation facilities and the economics of silver-lead-zinc production, conditions call for larger tonnage of better-grade and more regular ore than if the property was more cheaply accessible.

North Shore.—A limited amount of prospecting on this group of claims has disclosed irregularly-silicified limestone containing scattered streaks and patches of sphalerite mineralization, with minor amounts of galena, at several widely-separated points along the steep, densely-wooded slope to Nahwitti Lake at 575 feet elevation.

Two indefinite showings, at elevations of 625 and 775 feet, were examined in cuts near the western boundary of the claims east of Nahwitti River and just east of an area of hornblende latite. A selected sample from the upper point assayed: Gold, trace; silver, 6 oz. per ton; lead, 1.3 per cent.; zinc, 13.6 per cent. Another cut in this vicinity, at 725 feet elevation, exposes contact-metamorphic mineralization, consisting of magnetite and cupriferous pyrite,

trending south-westerly along the limestone-volcanic contact. Little work has been done on this showing, from which a selected sample assayed: Gold, 0.02 oz. per ton; silver, 1.2 oz. per ton; copper, 3.3 per cent. Another cut at 587 feet elevation, or just above the lake-level, and about 4,000 feet easterly from the previously-mentioned locations, exposes a stringer of sphalerite-galena mineralization, up to 14 inches wide, in silicified limestone just west of another area of hornblende latite. Here, as at the other points specified, conditions are indefinite.

South Shore.—Superficial prospecting on these claims has disclosed some indefinite mineralization, consisting chiefly of disseminations and streaks of sphalerite, with occasional galena, in a narrow belt of limestone bounded to the north along the lake by hornblende latite and to the south by shales, tuffs, and felsite. The showings examined are across the lake from and approximately opposite and south of the last-mentioned showing on the *North Shore* group. Located on the wooded, steep, north slope to the lake, between the lower limestone-volcanic contact at 800 feet elevation and the upper contact at 970 feet elevation, there are four small exposures of erratic low-grade mineralization at elevations of 810, 910, 935, and 955 feet respectively. They appear to be part of an extensive zone of altered limestone, silicified and iron-stained in part, irregularly mineralized with fine streaks and disseminations of the sulphides. Selected samples assayed: Gold, 0.02 oz. per ton; silver, 0.8 oz. per ton; lead, 13.3 per cent.; zinc, 9.8 per cent.; and: Gold, trace; silver, 0.6 oz. per ton; lead, 0.5 per cent.; zinc, 6 per cent. Silver-lead-zinc mineralization is reported to have been found at other widely-separated points, but these were not examined.

Dorlon. This group, in the Nanaimo Mining Division, consists of four claims held by location and owned by S. S. Pugh, of Port Hardy, and associates. It is situated to the south of the Upper Nahwitti River Valley about 7,100 feet easterly from the *H.P.H.* camp. Slopes adjoining the workings, at elevations varying from 910 to 1,020 feet, are northerly towards the valley at 675 feet elevation, the character of the timbered ground being irregular with occasional benches. The property is reached by a short branch from the main trail leading to the *H.P.H.* group about 16.16 miles from Port Hardy. General transportation conditions have been described in the foregoing *H.P.H.* report.

Limestone extends up the slope from the valley to an elevation of 1,020 feet over a distance of 2,000 feet or more measured from north to south. Towards the south-western corner of the claims there is a large area of dense siliceous volcanic rock. In the vicinity of the main showings, toward the centre of the square block of claims, the limestone is cut by a dyke of silicified and altered aplite, or felsite, 5 feet wide, which strikes north 20 degrees west and has a vertical dip. The mineralization consists chiefly of black sphalerite occurring in massive stringers or as scattered streaks replacing the locally dark to black, generally silicified limestone. Rare specks of galena are associated with the zinc sulphides at one point. Two samples of sphalerite mineralization contained from 0.54 to 0.94 oz. gold per ton and from 0.8 to 2.0 oz. silver per ton. The gold values are apparently associated with pyrite occurring in "hair-line" seams in the sphalerite.

The *Dorlon* claims, known formerly as the *Yucan* group, were staked in 1930, since when work has been confined to shallow cuts and stripping at a few points.

The most definite showing seen, 6 feet long and up to 28 inches wide, is situated on a local bench at 910 feet elevation and adjoins the previously-mentioned dyke to the east.

Structural conditions could not be ascertained due to the limited amount of work done. A channel sample across 28 inches of sphalerite-streaks with intervening oxidized seams assayed: Gold, 0.54 oz. per ton; silver, 0.8 oz. per ton; zinc, 33.6 per cent.; and a selected fresh sample of sphalerite, containing pyrite in cleavage planes, assayed: Gold, 0.94 oz. per ton; silver, 2.0 oz. per ton; zinc, 35.6 per cent. At points from 8 to 12 feet west of the dyke, dark limestone, containing scattered sphalerite streaks, is only slightly exposed. The above showings are near the south-west corner of the *Dorlon No. 1*, which is the north-eastern of the four claims in the block. To the south-west about 300 yards, roughly estimated, and on the *Dorlon No. 4* claim, at 1,020 feet elevation, a small patch had been lightly stripped showing silicified iron-stained limestone containing scattered streaks of the black sphalerite accompanied by occasional specks of galena. The gold values associated with the mineralization at the point sampled warrant systematic prospecting, the showings adjoining the dyke presenting an interesting objective for exploration. Gold values may be present at other points where similar sphalerite mineralization is in evidence but where little or no work has been done.

GOLD-SILVER-LEAD-ZINC DEPOSITS.

Pacific Great Eastern Railway.

Brandywine Creek Area.

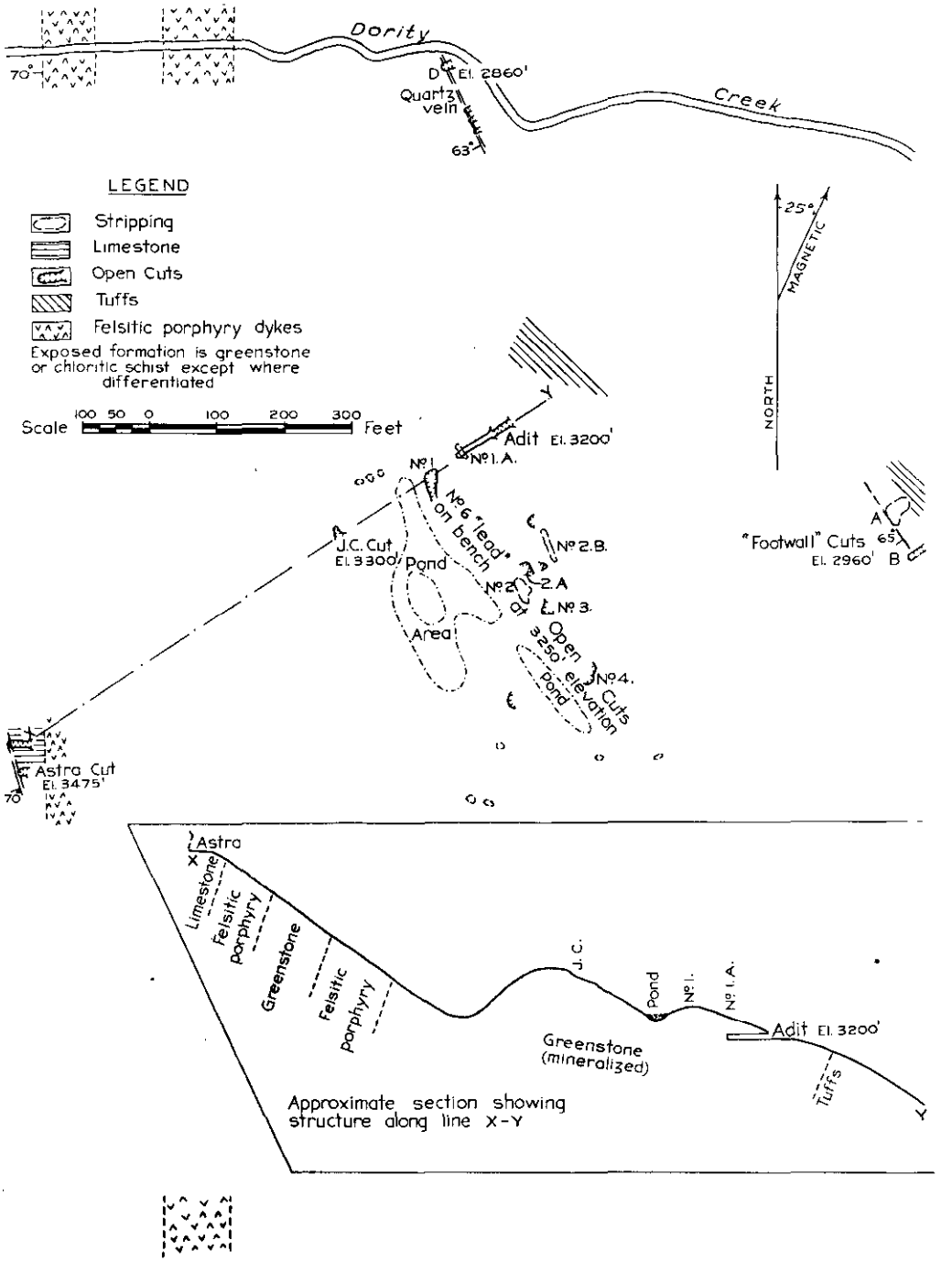
Astra and Cambria.

These groups, comprising thirteen mineral claims held by location, are in the Vancouver Mining Division, being owned by Frank Price, of New Westminster. The area adjoins or lies to the south and south-west of Dority Creek, an easterly-flowing tributary of Callaghan Creek, which, in turn, empties into the Cheakamus River just north of McGuire Siding on the Pacific Great Eastern Railway, 30 miles north of Squamish. The cabin is 2.5 miles north-west of McGuire, or about 100 yards east of the north-west corner of S.T.L. No. 43727, shown on B.C. Department of Lands Reference Map No. 62. Elevations on the claims range from 2,000 to 5,500 feet, as compared with 1,632 feet at McGuire. The workings examined vary in elevation from 2,440 to 3,475 feet, the main showings being situated on a bench, at 3,250 feet elevation, which interrupts the irregular but generally steep slope to Dority Creek. The ground is heavily wooded with hemlock, yellow cedar, and balsam, the useful trees being up to 3 feet in diameter. Neighbouring peaks of the Coast Range, lying west or north-west of the prospected area, are Metal Dome at 6,590 feet elevation and Mount Cayley at 7,852 feet elevation. Present means of access is by trail, about 3.5 miles in length, extending westerly from McGuire Siding as a good pack-trail for 2.5 miles to the *Blue Jack* prospect on Brandywine Creek, thence for 1 mile on a very steep grade extending northerly along Swede (Snow) Creek to its head. A better route for the *Astra* and *Cambria*, of about the same length from McGuire, could be located along Callaghan and Dority Creeks, which streams afford potentialities for water-power development. The B.C. Electric Railway Company power-line right-of-way from Bridge River crosses the flats below the property, presenting a possibility of commercial power being available at some future time when an adequate market is available for electrical energy.

The geology of the area has not been mapped, the nearest work of this nature being the "Reconnaissance along the Pacific Great Eastern Railway between Squamish and Lillooet," contained in Geological Survey of Canada Summary Report, Part B, 1917. The deposits are found in greenstone or its schistose derivatives, being part of a comparatively large area of Mesozoic, mainly Triassic, roof-pendant rocks within the Coast Range batholith of Jurassic age. The stratified rocks are represented locally by argillites, bands of limestone, conglomerate, and tuffs, interbedded with greenstones, chlorite, and talc schists. This series, which strikes north-westerly, with steep dips to the south-west, is intruded by several large dykes, up to 106 feet wide, of felsite and felsitic porphyry, which, extending for long distances in a north-south direction, are a marked geological feature of the area including the *Blue Jack* and *Brandywine* prospects, these being described separately. Stocks of diorite outcrop at points to the south of the prospected ground or at about 1,800 feet south of Dority Creek. The diorite, which is from green to nearly black in colour and varies in texture from coarse to fine grained, or porphyritic, is believed to represent an altered basic phase of the batholithic rocks.

Mineralization, of replacement-type, is exposed at numerous points in greenstone, where it is more or less silicified, and in chloritic schists, within an area about 1,500 feet long measured north-west and south-east and up to 1,300 feet wide from north-east to south-west. As shown on the accompanying sketch-map, two parallel felsitic porphyry dykes cut the greenstone towards the western margin of the area examined by the writer. These dykes, where intersected by Dority Creek, are 78 and 106 feet wide respectively, being separated by 102 feet of locally coarse-grained greenstone. Extending north-westerly across Dority Creek, the greenstone is bounded to the east by tuffs. In the same direction, 2,000 feet from the two big dykes, the formation is cut by a similarly wide north-south-trending felsite dyke, in the vicinity of stock-like outcrops of dark green, coarse-grained, altered diorite. About 2,600 feet south of Dority Creek there are north-westerly-striking argillites and slates which separate the *Astra-Cambria* greenstone area from the schistose greenstone and chloritic schist of the *Blue Jack* property. At the present stage of superficial exploration no evidence is afforded of definite structural boundaries to the widespread mineralization found in the greenstone in which shearing planes generally strike north 35 degrees west and dip 65 degrees to the south-west. The mineralized host-rock is in most places lightly capped with rusty, light-coloured, dense chloritic schist, silicified in places, in which pyrite is abundant and frequently accom-

panied by low-grade irregular disseminations of sphalerite and galena, manganese dioxide coating the rock at many points. In the underlying greenstone, where penetrated, there is an apparent improvement in the grade and continuity of the prevailing low-grade mineralization, and chalcopyrite, of sparse occurrence elsewhere, is more noticeable. In present



Astra and Cambria. Sketch-plan of Workings.

exposures, many of which have not reached the more favourable underlying rock, sphalerite, nearly always present to some extent, is frequently accompanied by galena in small percentages. All assays show some silver ranging from less than an ounce to 5 oz. per ton in channel samples and up to 8.9 oz. per ton in sorted material, the average content being small. Gold values, of interest because of the extensive distribution of mineralization, are generally very low, but appear to improve where chalcopyrite is present or in the more massive mixed sulphide occurrences. The best gold assays in the writer's channel samples were 0.07 and 0.08 oz. per ton and up to 0.12 oz. per ton in selected material. Seepages of secondary manganese are abundant in the vicinity of local fractures.

The property was staked by Frank Price and Bert Falconer in 1925, since when annual assessment-work has been performed. Among references to the *Astra* and *Cambria* contained in past Annual Reports, that for 1934, page F 14, contains assay returns of interest.

The area in which the most intensive prospecting has been done is about 500 feet long and 300 feet wide. This includes the open-cuts developing what is known as the "No. 6 lead," which is the most extensive of the mineralized zones indicated by the surface workings. The mineralization, only partially exposed in most cases, consists of light disseminations of pyrite, sphalerite, galena, and occasional chalcopyrite, with lenses or streaks of more concentrated mixed sulphide material. Large exposures are available for sampling, though these are not always at right angles to the north-35-degree-west trend of the sheared zone and widths must be reduced accordingly. Referring to the accompanying sketch, sampling results are appended below. Where blanks are shown in the copper, lead, or zinc columns, assays were not made for these metals, which, if present, were not in important amounts.

Sample No.	Location.	Width in Feet.	Bearing of Exposure sampled.	Gold.	Silver.	Copper.	Lead.	Zinc.
				Oz. per Ton.	Oz. Per Ton.	Per Cent.	Per Cent.	Per Cent.
6253-B	J.C. Cut	6	N. 35° E.	0.07	5.0	2.0	8.5	4.0
6254-B	J.C. Cut	Sorted		0.12	8.9	4.2	21.0	12.0
6255-B	No. 1 Cut	Selected		0.04	2.0		6.0	6.0
6248-B to 6251-B	No. 1 Cut	22.5	South	0.01	0.5		0.7	4.3
6246-B	No. 1 Cut	5	South	0.04	1.6	0.5	2.5	9.0
6245-B	No. 1 Cut	4.75	South	0.01	0.5		0.5	3.0
6244-B	No. 1 Cut	5	South	0.04	1.2		5.0	3.0
6252-B	No. 1-A Cut	2	N. 55° E.	0.01	0.4		Trace	2.0
6238-B	Adit	Specimen		0.05	5.2	2.0	11.5	21.0
6243-B	Adit	7	N. 57° E.	Trace	Trace		0.2	2.0
6240-B	Adit	6	N. 57° E.	0.02	0.6	0.1	0.5	4.0
6242-B	Adit	Grab		0.03	2.2	0.5	3.0	13.0
6263-B	No. 2 Cut	6	N. 55° E.	Trace	0.5		1.0	2.1
6264-B	No. 2-A Cut	5.5	N. 55° E.	0.03	0.6		1.2	2.5
6265-B	No. 2-B Cut	Selected		0.04	3.0		5.3	3.8
6261-B	No. 3 Cut	9	N. 55° E.	0.02	0.2		Trace	2.5
6262-B	No. 3 Cut	Selected		0.11	0.3		0.7	4.5
6256-B to 6260-B	No. 4 Cut	24.25	N. 70° E.	0.01	0.4		1.1	3.3
6239-B	No. 4 Cut	Grab		0.02	0.8		1.4	6.0
6266-B	Foot-wall Cut A	Selected		0.08	2.8		14.0	12.1
6267-B	Foot-wall Cut B	Selected		0.04	0.8			
6268-B	Foot-wall Cut C	5	N. 55° E.	0.08	0.4			0.5
6247-B	Astra Cut	Selected		0.04	5.4		25.5	21.0
6269-B	Quartz Vein at "D"	2	Normal to dip	0.22	0.6			3.4

Of the above samples, Nos. 6253-B to 6268-B, taken in succession as listed, represent the same general type of mineralization, consisting of pyrite, sphalerite, and galena, with occasional chalcopyrite, disseminated through a gangue of silicified greenstone, sometimes sheared and schistose, or of rusty cappings, generally more sparingly mineralized. The *J.C.* cut reveals the best mineralization seen and the 6-foot section sampled, No. 6253-B, appears to be part of an extensive zone partially exposed, but not sufficiently for sampling, for a further 15 feet along the same north-35-degree-east bearing, the showings being covered around the edges. Sample 6254-B from this cut was from a 2-ton pile of sorted material.

Samples 6248-B to 6251-B, No. 1 cut, are continuous sections for a total length of 37.25 feet along the south bearing of the exposure, the first four of which, representing 22.5 feet of uniformly low-grade mineralization, were averaged. The adit samples, Nos. 6243-B and 6240-B, represent sections between 49 and 56 feet, and between 56 and 62 feet in from the portal respectively. No. 6265-B, from No. 2-B cut, is selected material from outcrops over a length of 54 feet, this partial exposure being along the strike: No. 6247-B, *Astra* cut, represents selected material from irregular galena-sphalerite-pyrite streaks in rusty calcareous gangue, the mineralization being associated with a fracture in silicified dolomitic limestone west of the most western felsitic porphyry dyke. Sample No. 6269-B is from a quartz vein or zone which, striking north 15 degrees west and dipping 63 degrees to the south-west, has been exposed by open-cuts over a length of 175 feet adjoining Dority Creek. The quartz, from 8 to 24 inches wide, is irregularly mineralized with pyrite, sphalerite, occasional galena and chalcopyrite, the enclosing rock being chloritic schist.

Adjoining Dority Creek at four widely-separated points between the quartz vein at D, 2,860 feet elevation, and 1,000 feet easterly, at 2,440 feet elevation, open-cuts and stripping, not shown on the sketch, expose scattered sphalerite-pyrite mineralization, with occasional galena, in rusty silicified zones in schistose greenstone or chloritic schist. The planes of schistosity have variable strikes and dips, some noted striking north 20 degrees east and dipping steeply to the north-west, while others strike north 45 degrees west with vertical dips.

Summarizing conditions at the present stage of shallow, imperfect exposures, mineralization of the main type specified, generally very low grade, is remarkable for its extensive distribution. The *J.C.* showings, which may be part of a large body, contain interesting gold and silver values associated with appreciable percentages of the base metals, notably lead and copper. This indicates an interesting possibility for the development of valuable sulphide concentrations within the adjacent area, in which mineralization in some degree is practically always encountered in excavations, especially when the capping is penetrated. Apart from the better-grade section of the *J.C.* cut, there are lenses and stringers of material carrying a higher percentage of lead than appear in the channel samples. If the general type of mineralization is found to persist at depth, such material could be readily sorted on a large scale for a mill product.

Low but appreciable gold values, which are found in places as at the *Foot-wall, No. 3*, and *J.C.* cuts in the greenstone area, appear to improve with the presence of appreciable percentages of copper or in the more massive sulphide aggregates which include copper. Accessory gold may therefore be of value if large sulphide bodies are found, and in this event silver values might also be expected to improve. There are other types of mineralization such as the vein-like auriferous-quartz occurrence at " D " and the mineralized dolomitic limestone in the *Astra* cut, samples from both of these places being listed.

A great deal of prospecting has been done on the claims by the owner and his partner and not all the showings were seen by the writer. Of those examined, however, the *No. 6* zone and adjoining *J.C.* cut appear to constitute a first objective for future exploration, and in this connection the adit, if extended along its course of south 57 degrees west for about 265 feet, will reach the ground on the 65-degree dip below the *J.C.* cut at approximately 100 feet lower elevation. Conditions are well adapted for preliminary testing by diamond-drilling.

Blue Jack. This group, adjoining the *Astra* and *Cambria* property to the south, consists of eight claims held by location and owned by the Blue Jack Mines, Limited. Referring to the B.C. Department of Lands Reference Map No. 62, the property, in the Vancouver Mining Division, adjoins Brandywine Creek to the north at a point about 2.1 miles north-westerly from McGuire Siding on the Pacific Great Eastern Railway.

The workings, along the banks of Snow (Swede) Creek, a small tributary flowing southerly into the larger stream, are at relative elevations of from 2,100 to 2,700 feet, being situated on a steep well-timbered slope. The trees include fir, white pine, and cedar, some of the large firs being up to 5 feet in diameter. The rocks are covered with overburden, which is deep towards the southern end. Brandywine Creek is a boulder-strewn, torrential stream with a steep gradient towards Brew (Brandywine Falls), where, adjoining the railway, it has a direct fall of 185 feet. The property is conveniently reached by pack-trail 2½ miles in length from McGuire Siding, elevation 1,632 feet. For the first mile from the railway the trail follows an old logging railway-grade, then climbs the side-hill on a fair grade to the camp at at about 2,200 feet elevation.

The general geology of the neighbouring area has been indicated in the foregoing *Astra* and *Cambria* report. The schistose greenstone and chloritic schists enclosing the *Blue Jack* deposits are members of the same northwesterly-striking Mesozoic formations, being separated from the *Astra-Cambria* greenstone by an area of slates and argillites. A wide, northerly-striking felsite dyke, probably the extension of one of the two westerly dykes on the *Astra* and *Cambria* property, is partly exposed in crosscuts on the lowest adit-level. The *Blue Jack* deposits are associated with shearing which is marked at underground points by well-defined fracturing, sometimes accompanied by gouge, strikes being northerly, with a westerly dip from 60 to 70 degrees. The wide shear-zone contains scattered lenses, disseminations, and streaks of pyrite, sphalerite, and galena, at widely separated points on the surface and underground, no continuity of specific showings being apparent. The mineralization is associated in places with minor amounts of quartz accompanied occasionally by calcite, but the prevailing gangue is rock showing little or no apparent silicification. In the lowest adit, felsite-dyke exposures, more or less decomposed, are mineralized in places with sphalerite and pyrite in disseminations and fine streaks or as films in cleavage-planes. The average gold content is low, the better values being present in the mixed sulphide material. Appreciable silver values are occasionally associated with sphalerite showing no lead content.

The assay and analysis of twenty-nine sacks of selected material shipped to the Tacoma smelter in 1934 was as follows: Gold, 0.36 oz. per ton; silver, 3.16 oz. per ton; lead, 4 per cent.; zinc, 4.1 per cent.; iron, 4.6 per cent.; silica, 56.6 per cent.; alumina, 4.5 per cent.; lime, 8.2 per cent.; sulphur, 5.4 per cent.

The claims constituting the property were staked in 1923 and the Blue Jack Mines, Limited, a private company incorporated in 1932, was converted into a public company in 1936. The property, mentioned at intervals in the Annual Reports of the Minister of Mines since the year 1924, was briefly described in this publication for 1934, page F 14, since when the lowest adit has been driven.

The surface workings are distributed over a length of 1,030 feet through a vertical range of 575 feet. At elevation 2,675 feet open-cuts and stripping on both sides of the little creek partially expose the zone for a width of 53 feet. At the eastern end, next to the bank, there are scattered sulphide streaks and disseminations over a width of 7.5 feet. This mineralization could not be traced for any appreciable length due in part to overburden. Forty-one feet west of this a sample across 15 inches, where sulphides are concentrated, assayed: Gold, 1.42 oz. per ton; silver, 6 oz. per ton; lead, trace; zinc, 5.8 per cent. The latter appears to be a lenticular occurrence as it is 7 inches wide 2 feet to the north, where it goes under overburden and is not in evidence in the rock exposed 10 feet to the south. Between and adjoining the two points there is some very sparse, indefinite sulphide mineralization. Trenches have been dug on both sides of the portal of the upper adit at 2,650 feet elevation. In the eastern showing there is scattered, light, sulphide mineralization between points 23 and 38 feet from the portal. A picked sample of the best material assayed: Gold, 0.70 oz. per ton; silver, 2 oz. per ton; lead, 1.8 per cent.; zinc, 12 per cent. Just west of the adit-portal there is a stringer of similar character.

At 2,450 feet elevation, below the point where the creek forks, a cut exposes a width of 2 feet of galena-sphalerite-pyrite mineralization associated with calcite, continuity along the strike not being apparent. At 2,100 feet elevation, on the edge of Brandywine Creek, 50 feet westerly from the mouth of Snow (Swede) Creek, a small cut exposes an indefinite 12-inch patch well mineralized with sulphides, from which a picked sample assayed: Gold 3.2 oz. per ton; silver, trace; lead, trace; zinc, 2.8 per cent. The upper adit, at elevation 2,650 feet, is driven 85.6 feet along a bearing of north 37 degrees east, to where crosscuts extend 15 feet to north 58 degrees west and 47 feet to south 63 degrees east. These branches are approximately below the surface showings at 2,675 feet elevation. In the central part of the westerly crosscut there is width of 51 inches of sulphide mineralization in the floor against the southern wall. A sample across this width assayed: Gold, 0.30 oz. per ton; silver, 2.2 oz. per ton; lead, trace; zinc, 5 per cent. This does not show in the northern wall. In the easterly crosscut there is a 43-inch width of light sulphide mineralization in the southern wall at a point 21 feet from the main adit. In this case also the mineralization does not continue into the northern wall. The portal of the next adit is at 2,600 feet elevation, 115 feet south 22 degrees west from the upper adit-portal. This comprises 132 lineal feet of work, being driven north-east for 56 feet, then

northerly for 27 feet, then north-westerly for 31 feet, and finally northerly again for 18 feet to the face. At 25.5 feet in from the portal a shear is cut which strikes northerly, with westerly dip of 70 degrees. Adjoining this, there are streaks of sulphides associated with silicified rock. A well-defined fracture-plane of similar attitude, with gouge, is cut in the north-westerly course 36 feet back from the face. In the last 18-foot section there are sparsely-disseminated sulphides, over a width of from 1 to 2 feet, in the floor and roof along the western wall, and also, in places, streaks of sulphides on the eastern side of the drift. At a point 680 feet south 34 degrees 30 minutes west from the portal of the last-described working and at 2,200 feet elevation, the lowest adit comprises about 682 lineal feet of workings driven in 1935 and 1936.

Measuring from the portal, this main adit extends as follows: North 42 degrees east to 315.5 feet; north 14 degrees east for 23.75 feet to chainage 339.25; north 47 degrees east for 24 feet to chainage 363.25; north 30 degrees east for 76.5 feet to chainage 439.75; and finally north 35 degrees east for 130 feet to the face at 569.75 feet. Crosscuts have been driven as follows: (1) 36 feet to south 57 degrees east at chainage 135 feet; (2) 19 feet to south 68 degrees east at chainage 198 feet; (3) 14 feet to north 60 degrees west and (4) 6 feet to south 60 degrees east, both at chainage 285 feet; (5) 38 feet to north 60 degrees west at chainage 375 feet. The outer part of the main adit is largely in chloritic schist which grades imperceptibly into massive greenstone towards the inner extremity. In the No. 1 crosscut the chloritic schist is sheared along two fractures, one of which, adjoining the adit, strikes north 20 degrees east with 65-degree dip north-westerly, and the other, 25 feet easterly, strikes north with 60-degree dip to the west.

The No. 2 crosscut has caved in part since the time of the writer's first examination in 1935. In the face there was then observed a smooth well-defined wall marked with gouge, striking northerly and dipping westerly at 65 degrees. Between this shear and the main adit the rock is grey, soft, decomposed material, apparently a local patch of felsite dyke being along the general trend of the dyke cut in Nos. 3 and 5 crosscuts. In the No. 2 crosscut the crumbly gangue is comparatively well mineralized with disseminated fine streaks of sphalerite, and a sample taken by the writer in 1935 across 15.5 feet adjoining the adit assayed: Gold, 0.03 oz. per ton; silver, 20.6 oz. per ton; lead, trace; zinc, 2.2 per cent. The westerly 11-foot and 9-foot sections of the No. 3 and No. 5 crosscuts respectively cut the felsite dyke, the irregular eastern wall of which strikes from north to north 23 degrees east, the dip averaging 50 degrees westerly. In the more decomposed portions of both dyke-exposures in these crosscuts there are some very scattered streaks of pyrite and sphalerite. In the lowest adit-level no appreciable mineralization was observed in the greenstone or schist.

Surface prospecting, comparatively little of which has been done, might disclose more continuous showings, and in this connection the greenstone-schist area underlying the argillites to the north of the workings seems worthy of attention. Work had been suspended at the property when visited in October, 1936.

CINNABAR DEPOSITS.

Mud Creek Area.

Manitou Mining Co., Ltd.

This company's Mud Creek cinnabar property, in the Lillooet Mining Division, consists of fifty-nine mineral claims held by location, including the original *Rose* group of five claims acquired under option. The precise location of the property cannot be described in terms of existing maps, which are inaccurate in regard to the position and course of Mud Creek, which is a southerly-flowing tributary of Tyaughton Creek. According to the new topographical map in preparation by R. C. McDonald, of the Bureau of Geology and Topography, Ottawa, the Manitou Camp is located at 51 degrees 03 minutes 26 seconds latitude and 122 degrees 46 minutes longitude. It is situated on a bench at 3,820 feet elevation just east of Mud Creek (3,700 feet elevation), and half a mile up-stream from its junction with Tyaughton Creek at about 3,590 feet elevation. All elevations given are relative only, being based on aneroid readings. The workings, at elevations of from 3,710 to 4,111 feet, are on medium- to steeply-sloping ground which is lightly wooded. The property, formerly reached by pack-trail, is now accessible by the recently-constructed tractor-road, over which a truck has been driven. This road, about 8.5 miles in length, connects with the *Goldside* road at Cinnabar Creek, making a total distance of 17 miles

by branch road from the highway at a point 32.5 miles from Bridge River Station on the Pacific Great Eastern Railway.

The geology of the area has not yet been mapped. The prospected area is largely underlain by sediments of the Bridge River series and included greenstones and volcanic flows. The sediments consist chiefly of cherty quartzites with some argillites and shales. There is generally much overburden on the slopes, but a general section of the rocks, which locally strike north-westerly, is visible along Mud Creek where it flows south-westerly. The above formation is exposed along the creek for a length of 1.75 miles from its mouth, in which distance, marking the limits of the writer's investigation, it flows through two narrow canyons. Numerous dykes, some of which are very wide, have a general northerly to north-westerly strike, types noted being composed of hornblende andesite, andesite porphyry, basalt, and quartz diorite. The last-mentioned dyke is at a point three-quarters of a mile up-stream from the nearest known cinnabar occurrence. Mineralization is found in greenstones, and to a lesser extent in quartzites adjoining the contact with greenstone. In the partially-explored area, roughly 2,600 feet measured from north-west to south-east and 600 feet from north-east to south-west, the greenstones have been found to occur in irregular small blocks or patches due, it is thought, to dislocation caused by faulting, folding, or both. The general structure has not yet been determined, the limited amount of development having been done at widely separated points.

Cinnabar, which is the only metallic mineral noted, is found in sheared greenstone or in massive, amygdaloidal greenstone, the latter phase being traversed by numerous stringers and streaks of calcite. In the first case the cinnabar occurs in the shear-planes and in the second case it is distributed through the calcite and in amygdales. The texture of the mineral varies from the brilliant vermillion-red crystalline variety to brownish-red incrustations. Minute globules of native quicksilver are reported to have been observed in some specimens. The deposits are difficult to sample owing to the erratic distribution of the mineralization and the irregular boundaries and attitudes of the greenstone bodies. The writer's samples, taken where mineralization appeared to be comparatively concentrated indicate a low average mercury content. Similar material, if developed in quantity, would require sorting before treatment or selective mining would be necessary.

The nucleus of the property, known as the *Rose* group, was held by Ben Cromer for some years before 1936, when an option was acquired by the Manitou Mining Company, Limited. Control of this company was recently taken over by Eastern interests, financial arrangements having been made to continue development. R. H. Stewart has been appointed as their consulting engineer.

The workings develop separate showings, no correlation of conditions being possible at the present stage of exploration. Their position is approximately described by measurements and bearings from the camp. Workings in "No. 3 area" are on the locally steep westerly slope towards Tyaughton Creek. The principal showings here, north 55 degrees west, 1,370 feet from the camp, are in a trench, 73 feet in length, extending south 15 degrees east along the 4,015-foot contour, above which the ground gradually flattens to a high bench at 4,125 feet elevation. The formation has a local strike of from north 70 degrees east to north 75 degrees east, dips being northerly at steep angles, or vertical. From the northern end, going southerly, the following section is exposed: 11 feet of sheared quartzite; 1.5 feet of greenstone with calcite-streaks but no apparent mineralization; (sample section A) 2.5 feet of similar material but well mineralized as per sample, which contained 0.45 per cent. mercury; 3.2 feet of greenstone with quartzite inclusions, the complex containing rare spots of cinnabar; (sample section B) 3.5 feet of greenstone with calcite-seams, well mineralized with cinnabar, which contained 0.4 per cent. mercury; 8.2 feet of sheared complex of shale, quartzite, and greenstone; 5-foot andesite dyke striking north 60 degrees east; 23 feet of (chiefly) greenstone with calcite-seams, containing very sparsely-distributed incrustations of cinnabar; 16 feet of quartzite including rare stringers of calcite, these being lightly mineralized with fine seams of cinnabar. Just east of sample section B and at 4,021 feet elevation an adit has been driven easterly for 28 feet. It is largely lagged to support the shattered sheared rock, the face being in quartzite. The first part of this working apparently followed a "tongue" of greenstone, from which a pile of about 10 tons at the portal was derived. A grab sample from this pile contained 0.2 per cent. mercury. At 3,977 feet elevation and 160 feet south 62 degrees 30 minutes west of this point

an adit was in 10 feet along a course of north 20 degrees east, the face being in crushed quartzite.

" No. 2 area " workings are on the steep southerly slope to Mud Creek, No. 1 cut, at 4,111 feet elevation, just below the summit of the hill, being 1,015 feet north 36 degrees west from the camp and across the creek from it. Here the formation strikes north 20 degrees west to north 25 degrees west, dips being from 85 degrees westerly to vertical. Going westerly along the contour, the following section is exposed: 4 feet of quartzite which apparently extend easterly for 130 feet or more; 4.3 feet of sheared greenstone containing sparsely-distributed cinnabar, a sample of which gave a *nil* return; 3 feet of similar material containing apparent mineralization in a central streak 8 to 10 inches wide, from which a sample across 3 feet gave a *nil* return; 4- to 6-foot dyke of hard massive basalt striking north 50 degrees west, with a south-westerly dip of 70 degrees, including along its south-western border a 12-inch width of sparingly-mineralized calcite, a sample of which contained a trace of mercury; and finally 6 feet of brown shales. At 4,075 feet elevation No. 2 cut is 40 feet south 36 degrees east from No. 1 cut. At this lower point the quartzite-greenstone contact strikes north 7 degrees west, with an easterly dip of 75 degrees, quartzite also lying to the east of the greenstone. A sample across the 6-foot exposure of weathered greenstone and included calcite-seams, containing apparent sparse mineralization, assayed a trace of mercury. This No. 2 cut had only just entered solid rock after penetrating 9 feet of overburden.

At 3,921 feet elevation, and 215 feet south 13 degrees east from the No. 2 cut, an adit had been driven for 70 feet (August 11th, 1936) along a bearing of north 12 degrees 30 minutes west. At 40 feet in from the portal a 24-foot branch extended north 28 degrees east. Chaining along the main course from the portal, conditions are as follows: From zero to 30 feet, soil and boulders; 30 to 39 feet, sediments; 39 to 47 feet, greenstone; 47 feet to face, chiefly sediments, with mineralized greenstone coming in along the eastern wall towards the face. The north-easterly branch is mostly in greenstone, with some included sediments which also show in the face. A sample, weighing about 60 lb., from an irregular block of mineralized greenstone, about 8 by 10 feet, at the intersection of the main adit and branch, returned a trace of mercury. A sample in the main adit, between chainages 39 and 43 feet from the portal, gave the same result, and a sample between chainages 43 and 47 feet gave a *nil* return.

The " No. 1 area " workings, comprising surface-stripping and two closely-spaced short adits, are easterly from the adit of " No. 2 area," the upper adit-portal being 225 feet north 73 degrees east from the previously described adit and at 3,920 feet elevation. In this vicinity there are two small cuts distant 21.5 and 10.5 feet respectively along a bearing of north 25 degrees west from the upper adit-portal and at elevations of 3,945 and 3,936 feet. These cuts are located along the vertical contact of the greenstone and sediments, the latter rocks lying to the east. In the westerly side of the upper cut there are scattered incrustations of cinnabar, over a narrow width, in sheared greenstone. In the lower cut sheared greenstone, with no apparent mineralization, is exposed. Immediately above the adit-portal there is a width of 8 feet of greenstone, amygdaloidal in part. Along the contour of the side-hill, 18 feet south-westerly from the adit-portal, beyond a section of quartzite 3 feet wide, there is a 7-foot width of sheared greenstone irregularly mineralized with spots of cinnabar. This local showing could not be traced uphill in stripping over a length of 16 feet. The upper adit follows a curving north-westerly course for 25 feet, and 13 feet in from the portal has a westerly branch 12 feet in length. The main part of the working is in sheared to massive greenstone, including quartzite lenses, its branch being all in quartzite. In the floor of the adit, at the forks, there is a lenticular streak of scattered cinnabar mineralization along the approximately vertical contact which strikes north 40 degrees west. A grab sample from two piles of mineralized greenstone, aggregating about 20 tons, at the portal contained 0.2 per cent. mercury. Sixty feet north-easterly from the adit there is a large body of hornblende andesite striking north 20 degrees west. The lower adit-portal is 60 feet south 20 degrees 30 minutes east from the upper adit and at 3,886 feet elevation. Driven west for 35 feet, it passes through a few feet of greenstone at the portal, beyond which it is all in sediments.

Near the toe of the slope just above the creek-level, and at 3,710 and 3,715 feet elevation, there are two adits, 15 and 10 feet long respectively, which are 55 feet apart along the contour of the slope. The easterly of the two adits is situated 475 feet north 47 degrees 30 minutes west from the camp. Between the portal and the creek there is an open-cut extending south-

easterly for 20 feet and largely filled with debris. The cut was apparently all in greenstone, which, adjacent to the creek, is 18 feet wide. There are sediments to the east of the greenstone, tuffs to the west, and quartzites in the adit to the north-west. A grab sample from a few tons of mineralized greenstone in the cut returned a trace in mercury. The westerly 10-foot adit is all in purple tuffs.

"No. 4 area" workings are on the steep north-westerly slope to the creek. These include a 10-foot adit, at 3,822 feet elevation, driven south-easterly. Adjoining the adit-portal a trench, crosscutting the north-westerly strike of the rocks, exposes the following section going south-westerly along the contour of the slope: 8 feet of quartzite; 2 feet of impure greenstone containing spots of cinnabar (opposite adit); 18 inches of quartzite; 2 feet of greenstone sparingly mineralized with cinnabar specks and incrustations; 20 feet of quartzite; 4 feet of mixed purple tuff and quartzite; 3 feet of greenstone containing sparse cinnabar-stain; 10 feet of shales; hornblende-andesite dyke, of which a width of 10 feet is exposed.

Summarizing the above notes, no substantial body of valuable material had been opened up at the time of the writer's examination in August, 1936, the work done being scattered over a comparatively large area. The widespread distribution of the low-grade mineralization, almost always present to some extent where greenstone is uncovered, indicates possibilities that, by sorting or selective mining, an appreciable aggregate tonnage of treatment grade may be derived from the known widely-separated greenstone bodies or from others which may be uncovered.

SPECIAL REPORTS.

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

Lode-gold Deposits.

Bridge River Area.—Lucky Jem; Kelvin; B.R. Mountain Golds, Ltd.
P.G.E. Area North of Squamish.—Brandywine; Nani.
Coquihalla Area.—Brett Gold Mines, Ltd.
Vidette Lake Area.—Hamilton Mines, Ltd.; Telluric; Moon Group; Bull Moose.
Vancouver Island.—Regina Group.
Coast and Islands Area.—Blue Bells Gold Mining Syndicate; Enid-Julie; Douglas Pine.

Placer Deposits.

Wreck Bay, West Coast of Vancouver Island.

Some of these properties, described in former Annual Reports of the Minister of Mines, have had little development-work done on them in recent years, and others are not considered to have reached a stage of development or to be of sufficient interest to warrant inclusion of lengthy descriptions in the Annual Report.

PROGRESS NOTES.

LODE-GOLD DEPOSITS.

BY

THOS. R. JACKSON.

Bridge River Camp.

Pioneer Gold Mines of B.C., Ltd.—H. T. James, general manager; E. F. Emmons, mine manager; Paul Schultz, mill superintendent. This mine is situated at Pioneer and is a shaft operation, with Nos. 1, 2, and 3 shafts in use; No. 1 shaft is down to the ninth level, No. 2 shaft to the twenty-sixth level, and No. 3 shaft to the twenty-sixth level. Electric hoists are in use at each shaft.

During the year the deepening of No. 2 shaft from the fourteenth level to the twenty-sixth was completed and crosscuts driven from the shaft to the vein at the seventeenth, twentieth,

twenty-third, and twenty-sixth levels, and at the end of the year ventilation raise connections had been completed from the twentieth level upwards.

Development during the year consisted of 9,921 feet of drifting, 3,359 feet of crosscutting, 2,746 feet of raising, and 321 feet of diamond-drilling. One hundred and fifty-four thousand eight hundred and eighty-one tons of ore was mined and this yielded 69,407 oz. gold and 12,845 oz. silver.

There were 301 men employed.

Bralorne Gold Mines, Ltd.—Richard Bosustow, general manager; Fred Grey, general superintendent; E. J. Chenoweth, mine superintendent. During the year a total of 21,466 feet of exploration and development work was done in the *Bralorne* mine, including 1,145 feet of raises and 765 feet of shaft. The *King* No. 2 shaft was sunk to the 1,400 level and crosscuts driven on that level to the *King* and " C " veins, with several hundred feet of drifting on each.

The *Empire* level, connecting the *Bralorne* mines with the *Empire* mine (formerly called *Bradian*), was completed, thus allowing the transportation of the *Empire* ore underground to the *Bralorne* portal. Some bad curves were straightened out and a manually-operated block-light system installed. The *Empire* shaft was sunk to the 1,000 level, thus connecting up all the underground workings. Subsequent to this connection the *Coronation* shaft had only been used for ventilation. Motor-haulage was installed on the 600 level in the *Empire* mine and on the 1,000 level *Empire* mine.

Quite a number of stopes in the *Empire* and *Blackbird* mines have been changed from shrinkage to cut-and-fill on account of bad walls. A new underground powder-magazine was made, as was a new underground fuse-house. A raise was driven from the 800 level on the *Blackbird* vein to the 600 level; this permits transfer of *Blackbird* ore to the main haulage-level, as well as providing means for transportation of men and supplies from the main haulage-level to the 600 level of the *Blackbird* mine. The connection of the various working-places by the aforementioned drifts, shafts, and raises, as well as several other raises, has greatly helped the mine ventilation.

The tonnage mined during the year was 167,264 and this yielded 63,829 oz. gold and 20,478 oz. silver.

Wayside Consolidated Gold Mines, Ltd.—P. E. Ritchie, managing director; G. R. Bancroft, manager; E. H. Lovitt, mine manager. This mine is situated on the Bridge River Highway near Gold Bridge; there are seven adit-levels and four lower levels driven from a winze sunk from the lowest adit. The different levels are ventilated by natural means and ventilation in the lower levels is provided by a 10-horse-power electric-driven fan of 5,000 cubic feet capacity.

The mill, of 100-ton capacity, operated throughout the year and treated 37,535 tons of ore. The total development during the year consisted of 820 feet of raising, 415 feet of sinking, and 2,225 feet of drifting and crosscutting.

Pacific Eastern Gold Mines, Ltd.—Major Jas. R. Lower, president and general manager; R. H. Stewart, consulting engineer; Chas. R. Cox, mine superintendent. This property is situated in the Bridge River area adjoining the *Pioneer* gold mine to the east. The operation consists of a 600-foot adit driven on the north bank of Cadwallader Creek and a shaft 550 feet deep at the end of the adit. From the bottom of the shaft the main crosscut extends for a distance of 3,100 feet to the south and exploratory drifting to the extent of 2,543 feet has been done east of this crosscut. A winze was sunk to a depth of 230 feet, from which work is being done on the 690 level.

All power is electric, provided by the Bridge River Power Company, Limited, and all underground workings are electrically lighted. The mechanical plant consists of a 720-cubic-foot Gardner-Denver compressor driven by a 110-horse-power synchronous motor; the blacksmith-shop is equipped with an Ingersoll-Rand " C " sharpener, small electric grindstone, and other customary equipment. Hoisting is done by a double-drum Mead-Morrison hoist operating two 1-ton automatic dump-skips. Water is removed from the 72,000-gallon collecting-sump on the 370 level by a 500-gallon-per-minute Pomona pump.

Development during the year consisted of 2,543 feet of drifting, 2,244 feet of crosscutting, 230 feet of sinking, and 1,412 feet of diamond-drilling.

B.R.X. (1935) Consolidated Mines, Ltd.—E. R. Shepherd, general manager; Jack Wallace, mine manager. This mine has worked continuously with an average daily number of twenty-

five employees. On the main level the north vein was prospected by a 6- by 9-foot winze, sunk 140 feet; at the 100-foot point in the winze a small station was made and lateral drifts extended north and south for a total distance of 47 feet. Before suspending this operation 554 feet of diamond-drilling was done to locate veins at this level. The B south drift was advanced a total distance of 2,466 feet, with a total of 581 feet of crosscutting. With the object of gaining a shaft-site in the hanging-wall, a crosscut at approximate right angles to the main vein was driven in an easterly direction for a distance of 416 feet.

A rope raise, ore-pocket, shaft-station, and hoist-station were completed at the end of the year for sinking a 2½-compartment vertical shaft to an initial depth of 500 feet; this being the company's immediate programme for the early months of 1937.

Pilot Gold Mines, Ltd.—Bert Wing, general manager; Fred Bradley, mine superintendent. This operation was active most of the year, development consisting of sinking a 2-compartment shaft down to a depth of 300 feet. One hundred feet from the shaft-collar an exploratory drift was projected a distance of 75 feet to strike the shear-zone. At 300 feet another drift will be projected to intersect the shear.

A small hydro plant provides the power necessary to generate compressed air and electricity.

During the year an average daily crew of twelve men were employed.

The following properties in the Bridge River area operated during part of the year with crews varying from four to eight men: Kelvin Gold Mines, Limited; Reliance Gold Mines, Limited; Reward Gold Mines, Limited; Federal Gold Mines, Limited; Congress Gold Mines, Limited; Tuscorara Gold Mines, Limited; Canadian Rand Gold Mines, Limited; Monte Christo Gold Mines, Limited; and Moha Gold Mines, Limited. These are all in the development stage.

Ashcroft Area.

Martel Gold Mines, Ltd.—This property was worked part of the year with a crew of six men; the total drifting in this mine is now 1,000 feet approximately.

In the Ashcroft area the Hamilton Creek Gold Mines, Limited, worked for the greater part of the year with a crew of six men and did 850 feet of drifting and crosscutting; at the Telluric Gold Mines, Limited, a small amount of drifting was done.

Vancouver Island.

*Georgina Gold Claim.**—J. T. Williams and Associates, operators. This property is situated on Nanoose Creek about 18 miles from the City of Nanaimo, in a northerly direction. A short drift was driven from the shaft-bottom under the creek and some surface-trenching was done. There was no production from this prospect.

*Gem Gold Mine, Texada Island.**—Worked only part of the year.

Squamish Area.

Ashloo Gold Syndicate.†—This property is situated about 28 miles by road and trail from Squamish, on the Ashloo River. During 1936 a small Hadsell mill was constructed and the concentrates from the mill are shipped out by pack-horses to the Squamish River and from there by truck to Squamish.

COPPER-ZINC-GOLD DEPOSITS.

Vancouver Island.

*Tyee Consolidated Mining Co., Ltd., Mount Sicker.**—P. E. Peterson, superintendent. This property is situated on Mount Sicker, near Duncan, and comprises a number of mineral claims in that area and includes the old *Tyee* and *Lenora* mines. Very little work was done on the property during 1936, but at the end of the year preparations were under way for a resumption of operations, which included installation of a power unit; a few men were already on the ground for this purpose. There was no production from this property during the year.

* By George O'Brien. † By James Strang.

COPPER DEPOSITS.

Howe Sound Area.

*Britannia Mining and Smelting Co., Ltd.**—C. P. Browning, general manager; C. V. Brennan, assistant general manager; Chris G. Dobson, superintendent. Due to the rise in the price of copper, which stood at 8.375 cents per pound in January, 1936, and rose to 11.525 cents by December, the tonnage of the mines was steadily increased, the monthly tonnage in December being practically double that of January. The present monthly tonnage is around 170,000 tons, with all sections of the mine producing except the *Jane* and *Empress* mines. During the year 1,311,835 tons were mined and milled, producing 19,320,625 lb. copper; 624,198 lb. zinc; 13,033 oz. gold, and 89,700 oz. silver. The pyrite production was 62,872 tons.

The total number of men employed in and around the mines and mill and surface at the end of the year was around 900, compared with around 460 at the end of 1935.

Without any request by the men, this company has steadily increased wages as the price of copper advanced. The wages have been increased by 75 cents per day since copper was at its lowest price, and another 25 cents per day bonus is to be given when copper reaches 11½ cents. No increase has been made in either board or house rents.

The *Fairview* section of the mine was reopened in May and produced over 25 per cent. of the total output. The *East Bluff* section produced about 37 per cent. Both the *West Bluff* and *Victoria* tonnages have been greatly increased, producing 29.9 per cent. and 7.27 per cent. respectively of the output. The method of mining in the *East Bluff*, *West Bluff*, and *Fairview* mines is by means of the Britannia method of powder-blast mining and modifications thereof. In the *West Bluff* section the 200-foot lifts are being split into two, with a sub-level midway. This makes for better and safer mining.

Mining methods at the high-grade *Victoria* unit are similar to those of the past—namely, square set and rill stopes. All ground removed is closely filled with waste material from the two old glory-holes. The *Victoria* shaft has now been sunk to 3,500 level; this will be developed in 1937.

The precipitation plant on the surface continues to yield its quota of copper, which is recovered from the mine-waters.

The 4,100 adit has been continued throughout the year. This adit is 12 by 10 feet and is now in about 11,000 feet. Some parts of this working require close and heavy timbering.

Development has totalled about 14,750 feet, as follows: Drifts, 7,520 feet; crosscuts, 2,741 feet; raises, 3,589 feet; powder-blast developments, 2,509 feet; sinking, 62 feet; and 7,178 feet of diamond-drilling was done during the year.

NICKEL DEPOSITS.

*B.C. Nickel Mines, Ltd.**—The property of this company is situated near Choate and is under the supervision of C. B. North. No. 1 tunnel, which is about 4,700 feet long, extends through the mountain. The entrance is on the Texas Creek side and the exit on the Emory Creek side. There are four crosscuts off this tunnel on the north side and two on the south side. Six raises have been put up from these crosscuts, averaging from 150 to 350 feet. Extensive diamond-drilling has also been carried out.

During 1936 approximately 2,000 tons of ore has been shipped to Japan, all of this being stoped from the 1,600 crosscut.

QUARRIES, SHALE, AND CLAY DEPOSITS.

BY

James Strang.

Burrard Inlet.

Coast Quarries, Ltd.—The stone from the Granite Falls quarry is used for general construction-work. Employment has been very irregular throughout the year, the number of men being about ten when fully employed.

* By James Strang.

NORTH VANCOUVER AREA.

Deeks Sand and Gravel Pit.—T. O. Burgess, superintendent. This is a hydraulic operation. Electrical power is used for the operation of the plant. Condition of machinery, fencing, and other equipment was found to be generally in fair condition.

Cascade Sand and Gravel Quarry.—A. Ellis, superintendent. Work has been irregular throughout the year. Conditions at the plant were fairly good.

FRASER RIVER DELTA AREA.

Clayburn Co., Ltd.—The company's plant is situated at Kilgard, about 50 miles east of Vancouver. Fireclay, firebrick, and various refractory forms, as well as common brick and sewer-pipe, are produced.

The fireclay is obtained from near-by deposits, underground mining methods being used. A shale-quarry is also operated in conjunction with the fireclay mines.

A total of sixty-nine men were employed during 1936, ten in the mines and quarry and fifty-nine in the plant.

Gilley Bros.' Quarry.—Situated at Silver Valley, Pitt River. About twenty men are employed here, although work has not been regular. The plant is kept in good condition.

Maryhill Sand and Gravel Co.—Operated by Gilley Bros., Limited, situated on the banks of the Fraser River. The plant is operated electrically, and a power-shovel and conveyor-belt used in the gravel-pit. The entire plant is kept in good condition.

TEXADA ISLAND.

Pacific Lime Co.—A large limestone-quarry is owned and operated by this company at Blubber Bay, quicklime, hydrated lime, and various limestone products being produced. The quarry and plant, descriptions of which have appeared in previous reports, were operated throughout the year, an average of thirty men being employed in the former and thirty-five in the latter.

B.C. Cement Co., Ltd.—This company's quarry is situated on the opposite shore of Blubber Bay from the Pacific Lime Company. The limestone is shipped by scow to the cement plant at Bamberton. The number of men averages around seven. This plant is kept in good condition.

Van Anda Quarry.—A limestone-quarry operated by F. J. Beale, supplying limestone to the various pulp-mills and crushed limestone to the coal mines on Vancouver Island. Around twenty men are employed.

SAANICH INLET, VANCOUVER ISLAND.

B.C. Cement Co.—Operating two quarries and a cement plant at Bamberton. Work was irregular in the earlier part of the year. Around twenty men are employed at the quarry.

GABRIOLA ISLAND, VICINITY OF NANAIMO CITY, VANCOUVER ISLAND.

*Gabriola Shale Products, Ltd., Gabriola Island.**—Charles T. deLong, manager. This quarry is situated on Gabriola Island, in the Strait of Georgia. There is also a brick-making plant on the same property and a good grade of brick is made. The shale in the quarry if of good quality and is mined on the bench system. Blasting is under the supervision of a certificated blaster. All blasting is done electrically by battery and cable. This plant had been closed down for a couple of years and was in operation only three months in 1936.

COMOX AREA, VANCOUVER ISLAND.

*Public Works Gravel Pit, Courtenay.**—This gravel-pit is situated about midway between the Cities of Cumberland and Courtenay on the Cumberland–Courtenay Road. The material is used for road-making in the district. The face of this pit is about 75 feet high.

FITZHUGH SOUND, MAINLAND COAST.

Koeye River Quarry.†—P. Christensen, operator. This quarry is situated on Koeye River, about a half mile from its mouth, and is about 7 miles south of Namu. Five men were employed and 10,570 tons of limestone was produced and shipped to the Pacific Mills, Limited, Ocean Falls.

* By George O'Brien. † By Charles Graham.

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ILLUSTRATIONS.

VICTORIA, B.C.:
Printed by CHARLES F. BANFIELD, Printer to the King's Most Excellent Majesty.
1937.

4 '25-237 4740

The Annual Report of the Minister of Mines is now issued in parts as follows:—

Part A.—THE MINING INDUSTRY (STATISTICAL REVIEW). John F. Walker.

Part B.—NORTH-WESTERN MINERAL SURVEY DISTRICT (No. 1). Joseph T. Mandy.

Part C.—NORTH-EASTERN MINERAL SURVEY DISTRICT (No. 2). Douglas Lay.

Part D.—SOUTHERN AND CENTRAL MINERAL SURVEY DISTRICTS (NOS. 3 AND 4). M. S. Hedley.

Part E.—EASTERN MINERAL SURVEY DISTRICT (No. 5). H. Sargent.

Part F.—WESTERN MINERAL SURVEY DISTRICT (No. 6). B. T. O'Grady.

Part G.—INSPECTION OF MINES. James Dickson.