

BRITISH COLUMBIA
DEPARTMENT OF MINES

HON. WM. SLOAN, Minister.
R. F. TOLMIE, Deputy Minister. W. FLEET ROBERTSON, Provincial Mineralogist.
GEO. WILKINSON, Chief Inspector of Mines.

BULLETIN NO. 1, 1920

PRELIMINARY REVIEW AND
ESTIMATE OF
MINERAL PRODUCTION
1919

BY

WM. FLEET ROBERTSON, Provincial Mineralogist.



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To the Hon. William Sloan,

Minister of Mines, British Columbia.

SIR,—I beg to submit herewith a preliminary estimate of the mineral production of the Province for the year 1919, together with some notes on the progress of the mining and metallurgical industries during the year just closed; the information herein presented is, of course, subject to revision.

The object of this preliminary estimate and review is to give, as promptly as possible, after the close of the year, an approximate statement of the condition of the mining interests without waiting until the official returns from the mines have been received, and without the delay that of necessity must take place in carefully preparing the detailed information given each year in the Annual Report of the Minister of Mines.

The reviews herein given of the various mining districts have been submitted by the Resident Engineers of such districts.

I have the honour to be,

Sir,

Your obedient servant,

WILLIAM FLEET ROBERTSON,

Provincial Mineralogist.

Bureau of Mines, Victoria, B.C.,

January 2nd, 1920.

PRELIMINARY REVIEW AND ESTIMATE.
OF
MINERAL PRODUCTION FOR THE YEAR 1919.



THIS bulletin has been prepared before the receipt of the official reports for the year 1919 of the Gold Commissioners and Resident Engineers of the Province, and the customary returns of mineral production annually made by managers of mines and reduction-works; consequently, it must necessarily be regarded as being simply a preliminary review of the progress of the past year, together with an estimate of the quantities and value of the several mineral products of the Province, which it is believed will prove to be approximately correct.

The accompanying table shows an estimated mineral production during 1919 of a total value of \$33,421,333. It will be seen that the total value of the production of 1919, as estimated, is \$8,361,141 less than that of 1918, equivalent to a decrease of about 20 per cent.

This decrease in production, as compared with the preceding year, loses its adverse significance when it is considered that the 1919 production is still materially greater than that of any year prior to 1916, and that the larger productions of the years 1916-17-18 are due to the stimulus of war and the inflated metal prices attendant thereon.

So that any feeling of regret at this year's output being less than that of the previous three years is completely obliterated by the consideration of the removal of the cause of the abnormal outputs of these three years—the war—and it becomes a matter of congratulation that, with the return of something approaching normal conditions, we should still find this year's mineral-output showing a very material increase over those of former normal years.

It will be noted from the accompanying table showing the details of production that this year's decrease is almost entirely due to copper—to the lesser quantity produced and the lower market price obtained for such product. To this must be added the consequent lessening of the production of both gold and silver to the extent that these metals would be contained in the decrease of tonnage of copper ore mined.

As the position of the copper-output is the important feature for consideration in this year's summary of production, it may be well to outline the conditions surrounding the marketing of this metal during the past few years.

Copper is such an essential war metal that all the Allied nations had felt obliged to accumulate within their borders a sufficient supply of the metal for war needs for a considerable time in advance, in case transportation facilities should cease.

The sudden coming of the Armistice in the fall of 1918 found all the great nations with these very large stocks of copper on hand, and no further demand for war supplies. It was estimated roughly that the stocks on hand were sufficient to supply the demands on a peace basis for about two years without further production by the mines.

As a consequence of the war the copper market of the world has been, during the whole of the year 1919, in a thoroughly demoralized condition and with no certainty as to the near future.

During the latter part of the war the market price of copper had been fixed by the United States Government, and, as the United States produces about two-thirds of the world's copper-supply, the American price formed the basis of the world price. The price thus set during the latter months of the war was 26 cents a pound at New York.

With the sudden disappearance of the cause of the great consumption, and with large stocks already distributed, it became at once evident that the fixed war price could not be maintained.

On the other hand, the producers, who had greatly increased their plants and outputs under the pressure of war's demands, found themselves with immense stocks on hand, and an accumulating increased output which had been produced under war conditions as to costs, and which they could not sell, without a loss, for much below the fixed war price.

The producers made an attempt, through combination, to maintain the fixed price, but the consumer did not have to buy, and consequently, as a matter of fact, practically no sales took place for some months around the end of 1918.

The great producers' combination immediately set about reducing their production to a point much below normal, hoping that the immediate coming of peace, with its expected greatly increased industries and the rehabilitation from war's devastations, would soon exhaust existing stocks.

This hope was to a great extent frustrated by the unexpected delay in settling the peace terms, and the slowness with which the expected rejuvenation of the peace industries has been taking place, due to the almost universal social unrest.

The burden of maintaining a profitable price over such an unexpectedly long time became too great for the producers, and they were, to a certain extent, forced to realize on their holdings at a reduced market price.

Whether the present price has reached bottom or whether it is being partially sustained artificially is unknown; hence the continuing demoralization of the market; but it seems certain that the present price obtainable is not high enough to permit of a continuation of production under the present scale of higher wages and high costs of necessary mining supplies. This latter phase is being reflected in a slightly rising market price during the last month of the year. Should this rise not continue until it reaches the present cost of production, it will mean continued curtailment of production and the eventual elimination of the less economically well-conditioned producers.

Such is the uncertainty attending the market conditions of the near future, in the light of which it is impossible to predict, with any degree of certainty, what output in copper our British Columbia mines will make during the coming year. Should the market price improve somewhat, or should the items affecting the cost of production diminish, we can confidently predict a much increased output, for the mines are in a position to make it, should the conditions render it commercially profitable so to do.

The value of the products of the metalliferous mines this past year is estimated to be about \$20,095,057, a decrease of \$7,815,221 as compared with the preceding year.

This is almost entirely attributable to a decreased output of copper and a lower market price for the product, as has been already commented upon and further explained in the later notes on the metal.

Generally the outlook for 1920 is most reassuring. The opening of new camps in the Portland Canal district has been the outstanding event of the past few months. There is no doubt that this district will be subjected to extensive prospecting and development this year. In short, there is every reason to believe that 1920 will be most important to the Province in point of mining development.

The production of gold, both placer and lode, shows a decrease of about \$506,947, as is fully pointed out in the detailed notes on that metal. With the value of the product fixed, while the abnormally high prices of all items entering into the costs of production remain as they are, the condition of this branch of the industry never can be satisfactory.

The output of silver shows an increase both as regards quantity produced and the value of the product. Silver is the only metal in the list the price of which may be considered abnormally high, and from the present outlook this high price seems likely to continue for some years, to the great advantage of the mines producing the metal.

In British Columbia our silver is almost entirely derived from ores carrying also other metals which have not increased in value.

The production of lead shows a decrease, due partly to strikes at some of the larger producing mines, and on account of the low price of the metal due to an overstocked market.

As regards quantity, zinc shows a somewhat increased production as compared with 1918, but due to a lower market price the value of this year's product shows a decrease. A considerable portion of the ore mined or concentrates produced found their way to the United States for smelting, the returns from which can at present only be estimated until final returns are received.

The collieries of the Province about held their own as far as production was concerned during the past year. The Coast collieries show an increase, but the Crowsnest collieries show a slight decrease in coal produced and a large decrease in the amount of coke produced, due to a long-continued period of labour trouble, to some extent due to the large percentage of aliens employed in and about these mines. Due to this fact the total value of the products of the collieries appears to be this year about \$357,718 less than in 1918.

Increases in the selling-prices of coal have been allowed at various times in the past few years by the Dominion Government Fuel Controller, until as nearly as can be calculated the average price of coal for the year, over the Province as a whole, has been about \$5 a ton, and the similar average price for coke about \$7 a ton.

MINERAL PRODUCTION FOR TWO YEARS, 1918-19.

The following table shows the quantities and value of the several minerals produced in the year 1918, and the estimated production in 1919. It may here be explained that the prices used in calculating the estimated value for 1919 of silver, lead, copper, and zinc are the average prices for the year, as published in *The Engineering and Mining Journal*, New York, less a deduction of 5 per cent. off silver, 10 per cent. off lead, and 15 per cent. off zinc.

MINERAL PRODUCTION FOR TWO YEARS, 1918-19.

	PRODUCTION, 1918.		ESTIMATED PRODUCTION, 1919.			
	Quantity.	Value.	Quantity.	Value.	Increase.	Decrease.
Gold, placer.....oz.	16,000	\$ 320,000	14,325	\$ 286,500		\$ 33,500
Gold, lode.....oz.	164,674	3,403,812	141,769	2,930,365		473,447
Total gold.....		\$ 3,723,812		\$ 3,216,865		506,947
Silver.....oz.	3,498,172	3,215,870	3,667,516	3,871,063	\$ 655,193	
Lead.....lb.	43,899,661	2,928,107	32,134,136	1,658,121		1,269,986
Copper.....lb.	61,483,754	15,143,449	45,984,046	8,631,205		6,512,244
Zinc.....lb.	41,772,916	2,899,040	43,694,583	2,717,803		181,237
Total metalliferous.....		\$ 27,910,278		\$ 20,095,057		7,815,221
Coal..... tons, 2,240 lb.	2,302,245	\$ 11,511,225	2,357,218	\$ 11,786,000	274,865	
Coke..... tons, 2,240 lb.	188,967	1,322,769	98,598	690,186		632,583
Total collieries.....		\$ 12,833,994		\$ 12,476,276		357,718
Miscellaneous and building material.....		\$ 1,038,202		\$ 850,000		188,202
Total production.....		\$ 41,782,474		\$ 33,421,333		\$ 8,361,141

PRODUCTION OF VARIOUS MINERALS BRIEFLY REVIEWED.

In order to indicate in a general way the sources of the various minerals mined in the Province and to give an idea of some of the conditions that affected their production, and, incidentally, brief information concerning the larger known mineral-deposits occurring in British Columbia, the next following comments are submitted.

Gold.

Placer Gold.—The recovery of placer gold for 1919 is estimated at \$286,500, of which practically all is obtained in the Cariboo and Cassiar Districts, only about one-twentieth of the total coming from the other districts. An approximate apportionment is as follows: From Cariboo District, \$80,000; Atlin Division of Cassiar District, \$175,000; Stikine and Liard, \$18,000; remaining parts of the Province, \$13,500. It may be that a larger yield will be shown, but this cannot be definitely stated until after the final returns of the season's operations shall have been received. This estimated production for 1919 shows a decrease from the preceding year of \$33,500, or about 11 per cent.

During the last four years the production of placer gold in the Province has steadily decreased. The chief reason is to be found in the economic conditions of high prices for labour and supplies, which made placer-mining less profitable than in former years. Shortage of labour also handicapped operations.

No definite information is available regarding the Atlin Division, but it is known that the production was considerably less than in 1918, and that some of the former operating companies were closed down during the year.

Lode Gold.—The quantity of lode gold produced in 1919 is estimated at \$2,930,365, as compared with \$3,403,812 in 1918, a decrease of \$473,447, or 14 per cent.

The decrease in 1919 is due to a big reduction in output from the Boundary-Yale District, a decline of approximately \$500,000 as compared with 1918. During the year the Granby Company closed its mines and smelter in this district and therefore only made a small production. The low-grade copper ore handled carries small gold and silver values, and in former years this gold production amounted to a considerable total. The *Nickel Plate* mine in this district also made a decreased production.

The Rossland mines, which prior to 1917 contributed annually about one-half of the output of lode gold, made about the same production in 1919 as in the preceding year; during these two years about one-quarter the normal output was made.

The following table shows the gold production of 1918 and the estimated production for 1919:—

	1918. Oz.	1919. Oz.
Boundary-Yale	56,169	30,952
Rossland	43,745	43,620
Cassiar District	48,016	59,779
Coast (Southern)	5,565	4,327
Lillooet	2,473	2,575
Nelson	7,155	153
All others	1,551	363
Totals	164,674	141,769

From the above table it will be seen that the only districts to show an increase are the Cassiar and Lillooet Districts. In the latter case the increase was small. The increase in Skeena is due to a larger output from the *Surf Inlet* mine, and the commencement of new shippers—viz., the *Premier* in the Salmon River section and the *Dolly Varden* mine in the Alice Arm section. The outlook for the future in this latter district is most promising and a largely increased production of gold and other metals may be expected.

The decrease in Nelson Division is large and is mainly due to the *Yankee Girl* mine being closed all year. Developments in this district at present under way may bring the production up again to that of former years.

The production of gold in British Columbia during each of the last three years has only been about one-half that of those years before the war, and shows that gold-mining in this Province has, as elsewhere in the world, been adversely affected by the conditions of high costs and a standard price for the product. Nevertheless, from the developments now in progress it would seem that in a short time the annual production of gold in British Columbia should increase considerably.

Silver.

The quantity of silver produced is estimated to have been about 3,667,516 oz., worth \$3,871,063, an increase from the production of 1918 of 169,344 oz., and, owing to the higher market value of silver, a larger percentage increase in value of \$655,193.

The market price of silver gradually rose during the year, the average for January being 101.125 cents an ounce, while in December it was about 132 cents. The average for the year was 111.103 cents (December estimated), the highest that silver has been for many years back. The prospect of silver maintaining its present price of well over \$1 an ounce is good, and in this respect the silver market is in marked contrast to the other metals, the future prices of which are uncertain.

The following table shows the silver production for 1918 and the estimated production for 1919:—

	1918. Oz.	1919. Oz.
Slocan and Slocan City	1,873,236	1,917,663
Skeena	416,616	908,685
Fort Steele	261,497	236,750
Boundary-Yale	228,561	150,684
Ainsworth	228,699	112,433
Coast (Southern)	116,425	119,308
Windermere-Golden	91,784	80,423
Nelson	136,738	53,454
Omineca	84,125	42,150
All others	60,491	45,966
Totals	3,498,172	3,667,516

An increased total production this year of 169,344 oz. of silver.

The above table shows an increase in the silver production from the Slocan, Skeena, and Coast (Southern) Districts, and decreases in all the others.

Two factors have affected silver production during the year, one favourably and the other adversely. In the first place, the high market price of silver has been a great incentive to the mining of silver-bearing ores. On the other hand, the lessened demand and lowered market price of all other metals has led to the curtailment of output in many mining camps where silver is produced merely as a by-product. British Columbia has practically no mines producing exclusively silver, but the silver-lead-zinc ores of the Slocan District have a high percentage of their values in silver. In this connection it may be noted that about 75 per cent. of the total Provincial output of silver comes from the treatment of silver-lead-zinc ores and the balance mainly from the smelting of copper-gold-silver ores.

A reference to the notes on copper will show that the production of that metal has decreased this year about 25 per cent. as compared with last year, and, as all our copper ores carry some silver, the lessened tonnage of copper ores smelted has reduced the silver production by the amount of the content of such ores. Considering these facts, the increased production of silver in 1919 as compared with 1918 is gratifying.

The greatest increase was made in the Skeena District and is accounted for by new shippers entering the lists. Two of these, the *Premier* and the *Dolly Varden* mines, give promise of swelling the silver production very materially during future years.

The Slocan District is again far in the lead of all other districts in silver production, 52 per cent. of the total being credited to the Slocan. The figures for this year indicate an increased production for the Slocan, as compared with last year, of about 2.3 per cent.

The largest producers in the Slocan were the *Hewitt-Van Roi*, *Surprise*, *Queen Bess*, *Silversmith*, and the *Standard*. There were nearly forty shipping mines in the district in 1919.

About 50 per cent. of the silver-output from the Boundary District comes from the Granby Company's mines at Phoenix. Other mines contributing are the *Mother Lode*, *Sally*, and *Union*.

The silver production from Trail Creek comes from the smelting of the gold-copper ores of Rossland camp, which carry about $\frac{1}{2}$ oz. of silver to the ton.

The Coast production of silver comes from the smelting of copper ores carrying low values in the precious metals. As a larger tonnage of copper ore was smelted, the silver-output shows an increase.

Lead.

The total amount of lead produced in 1919 is estimated to have been 32,134,136 lb., valued at \$1,658,121. This represents, as compared with the previous year, a decrease in quantity of 11,765,525 lb., and with the lower market price of lead a decrease in value of \$1,269,986.

During the first half of 1919 the market for lead was in a dull and demoralized condition owing to conditions arising from the sudden stopping of the war. Large stocks of lead were on hand for war purposes when the Armistice was signed, and also all lead-producers were speeded up to a high capacity. When the abnormal war demand for lead ceased, the market price dropped and production was curtailed until the surplus stocks were consumed by normal demand. The Consolidated Mining and Smelting Company, which treats at its smelter and refinery at Trail nearly all the lead produced in Canada, was heavily stocked with lead when the year opened, and as a result had to refuse to take lead ore for some time from the mines.

During the year the lead market gradually adjusted itself to normal demands and now seems to be in a fairly healthy condition.

The average price of lead in January in New York was 5.432 cents a pound, and although fluctuating somewhat it was not until August that any material advance was made. Slight advances continued until the average for December was about 7 cents a pound. The average price for the year was 5.736 cents, as compared with 7.413 cents in 1918.

The following table shows the production of lead, according to districts, for the year 1918 and the estimated production for 1919:—

	1918. Lb.	1919. Lb.
Fort Steele	18,695,565	14,100,000
Slocan	14,575,379	12,129,796
Ainsworth	6,106,262	3,785,110
Windermere-Golden	2,659,210	1,592,000
Nelson	1,611,166	374,300
All others	252,079	152,930
Totals	43,899,661	32,134,136

From the above table it will be seen that the decrease in output was general in all districts, and shows that the different mines throughout the Province were forced to curtail their outputs.

Fort Steele Division again leads all other districts. The *Sullivan* mine contributes nearly all of this production as a rule, but this year over 2,500,000 lb. came from the *North Star*.

In the Slocan District the heaviest producer in 1918 was the *Queen Bess*, followed by the *Surprise*, the *Silversmith*, and the *Hewitt-Van Roi*.

In the Ainsworth Division the largest producer was the *Florence*, with an output of about 2,000,000 lb., followed by the *Spokane-Trinket*, with approximately 400,000 lb., and about seventeen smaller shippers.

The lead production of Nelson Division comes mainly from the *Emerald* mine, and this mine produced very much less than in the previous year.

The production from Windermere-Golden was chiefly from the *Paradise* mine, with a production of about 1,250,000 lb., and seven small shippers.

Copper.

The amount of copper estimated to have been produced in 1919 shows, as compared with the previous year, a decrease in quantity, and, owing to the lower market selling-price, a large decrease in value. The production is estimated at 45,984,046 lb., which is 15,499,708 lb. less than the 1918 output; the value for this year is \$8,631,205, which, compared with \$15,143,449 made in 1918, shows a decrease of \$6,512,244.

The demoralized condition of the copper market during 1919 has been referred to somewhat fully in the opening pages of this bulletin, so that it is not necessary to further discuss it here, but some figures regarding the market price of the metal are given.

The year commenced with practically no sales of copper in January; in February the average price, according to the *Engineering and Mining Journal*, was 16.763 cents a pound. By August the price rose to 22.319 cents a pound, but to some extent the market was artificial, as the demand was very considerably less than the supply. From August to the end of the year the price declined again, and the average for December was about 18.5 cents a pound. In the last two weeks of the year the market appeared to have a healthier tone, and the price advanced slightly. The average price for the year was 18.77 cents a pound (December estimated), as compared with 24.63 cents in 1918.

The following table shows the production of copper, according to districts, in 1918 and the estimated production in 1919:—

	1918. Lb.	1919. Lb.
Skeena	30,190,606	20,730,685
Coast (Southern)	18,475,013	20,219,724
Boundary-Yale	10,477,833	3,432,327
Trail Creek Division	1,654,356	1,584,980
All others	685,946	16,330
Totals	61,483,754	45,984,046

From the above table it will be seen that there was a decrease in output from every district except the Coast (Southern). The main producer in this district is the *Britannia*, and this property mined and milled a larger tonnage in 1919 than in any previous year. Considering the adverse market conditions, this increased production of the *Britannia* mine shows the satisfactory condition of the property.

Early in the year the Granby Company was forced to close down the low-grade mines at Phoenix and smelter at Grand Forks, resulting in a great decrease in the copper production of Boundary-Yale District.

The Granby Company also curtailed production at the mines and smelter at Anyox, with the result that the copper production was about two-thirds that of last year.

The *Marble Bay* mine at Vananda was operated during the year, but a smaller production was made than in 1918.

The *Rocher Déboulé* mine, in Omineca Division, was closed all year, with the result that practically no copper was produced in that district.

Zinc.

The quantity of zinc estimated to have been produced in 1919 amounted to 43,694,583 lb., which, compared with 41,772,916 lb. produced in 1918, shows an increase of 1,921,667 lb. This

production is valued at \$2,717,803, which shows a decrease, as compared with the 1918 value, of \$2,899,040, due to the decreased market price of the metal.

The zinc market was not as much affected as the copper and lead markets by the transition period from war demands to peace conditions, with the result that the price of the metal did not fluctuate greatly and production continued uninterruptedly.

In January the average price of zinc in New York was 7.272 cents a pound; by May it had fallen to 6.429 cents, but thereafter gradually rose until the end of the year, the average for December being about 8.5 cents a pound. The average price of zinc for the year 1919 was 7.317 cents a pound (December estimated), as compared with 8.159 cents for 1918.

It should be noted that the 1919 production of zinc is the highest, as to quantity, in the history of the Province, although owing to a lower market price the value of the zinc production is less than in each of the three preceding years.

The following table shows the production of zinc, according to districts, for 1918 and the estimated production for 1919:—

	1918. Lb.	1919. Lb.
Fort Steele	26,704,806	32,200,000
Slocan	14,107,682	11,115,983
Omineca	313,112	273,000
Ainsworth	640,991	105,600
All others	6,325	.....
Totals	41,772,916	43,694,583

From the above table it is seen that the only district showing increased zinc production in 1919 was Fort Steele. The output in this district is made by the *Sullivan* mine, and the increase was due to a larger tonnage being handled at the Consolidated Company's electrolytic zinc-refinery at Trail, where the ore is treated.

In the Slocan District the heaviest shipper was again the *Standard*, with a production of nearly 5,000,000 lb., which, however, is 2,000,000 lb. less than in 1918. The next largest shipper was the *Hewitt-Van Roi*, followed by the *Surprise*.

The estimate for Ainsworth is only about one-sixth of last year's production, but final figures may bring the output for this Division up considerably.

The Omineca production is mainly a silver-zinc concentrate from the *Silver Standard* mine at Hazelton.

Other Minerals.

Iron.—So far there has been no iron produced in British Columbia, but it has been strongly advocated in many quarters that the conditions are favourable for the establishment of an iron-smelting plant somewhere on the British Columbia coast. So far nothing definite has materialized, although there is apparently a prospect of such a plant being established.

As is well known, there is on the Coast, in the aggregate, an adequate supply of magnetite-iron ore, quite sufficiently free from impurities as to be within the "Bessemer limit" to supply ore for such a plant.

Important bodies of limonite ore have been discovered in the Chilcotin district, which were examined by Mr. Brewer, his notes on which are included in his report, published herein under heading of "District No. 6."

About 25 tons of magnetite was shipped by this Department from Texada island to Vancouver for an experiment in electric smelting by the Fleet process, from which process, however, no satisfactory results were obtained.

Platinum.—The well-known fact of the wide occurrence of platinum throughout the Province in connection with our placer-gold deposits gives reasonable hope that such may be found in payable quantities and justifies further investigations.

As far as reports received indicate, the only output this year is about \$1,500 worth from the Similkameen District, in which district the Dominion Government was last year making a search for the metal for war purposes, but this work has now ceased.

Molybdenite.—Since the Armistice the market is dormant, like other metal prices, but nominal quotations vary from 75 cents to \$1 a pound. So far no advice of any shipment this year has been received.

Chromite.—In 1918 about 800 tons of chromite ore, carrying from 30 to 45 per cent. chromic oxide, was shipped from the *Mastodon* claim, Grand Forks Division; and a deposit on Scotty creek, near Clinton, was opened up, but no shipments were made.

With the end of the war the market for chromite temporarily collapsed, as large stocks were available, with no purchasers in sight. It is believed that no ore was shipped in 1919.

Manganese.—Nearly 600 tons of manganese ore, running over 50 per cent. manganese and less than 20 per cent. silica, was shipped from the *Hill 60* property on Cowichan lake before the roads became impassable through winter rains. The company is now arranging for the installation of an aerial tramway, which should prevent, in the future, interruption to sustained shipments.

About 100 tons of high-grade manganese ore was also shipped from the Curle *Manganese* group near Kaslo. Both shipments went to the Bilrowe Alloys Company, of Tacoma.

Non-metallic Minerals.—About 1,600 tons of fluorspar was shipped from the *Rock Candy* group, in the Grand Forks Division. This property is owned by the Consolidated Mining and Smelting Company and is being equipped to make steady shipments in the future. The mineral is shipped to the Trail smelter and is used for making hydrofluoric acid, which is used in the lead-refinery, and to other points in Canada and to the United States.

Shipments of magnesium sulphate (Epsom salt) were made from Spotted lake, Osoyoos Division, but figures have not been obtained. Seven hundred and fifty tons of magnesium sulphate was shipped from deposits of this material near Clinton.

Deposits of hydromagnesite in the Clinton Division, which are reported to be large and of great purity, have attracted considerable attention during the past year. No shipments have been recorded.

A production of arsenic valued at \$17,000 was made by the *Nickel Plate* mine in 1919.

Structural Materials, etc.

The output during 1919 of all structural materials, such as cement, lime, building-stone, sand and gravel, brick, and other clay products, will probably show a slight decrease from that of previous years.

The output for 1919 is estimated at \$800,000, as against \$940,891 in the preceding year.

Since 1912, when a production amounting to \$3,435,722 was recorded, the output of building materials has steadily declined, due to the cessation of the building trade, brought about by the continued financial depression, and the war. It is probable that the figures have now reached a minimum, and that an output amounting to about \$1,000,000 represents the steady yearly demand for these materials for use in repairs, renewals, and various small demands, without any new construction-work. It may be expected, therefore, that the production will remain at about this figure until a period of active construction-work again commences in the Province.

Portland cement is at present the most important item in the production of building materials, amounting this year, it is estimated, to less than \$300,000.

The outputs of building-stone, crushed rock, sand and gravel, and red brick have fallen to very low figures. A considerable quantity of firebrick and similar material is made, principally by the large plant of the Clayburn Company.

Coal and Coke.

It is estimated that the gross production of coal was 2,504,423 long tons, of which 147,205 tons was made into coke, leaving the net production at 2,357,218 tons. These figures show a decrease, as compared with 1918, of 74,301 tons gross and an increase of 54,973 tons net. The quantity of coke made was about 98,598 tons, which is a decrease of about 90,369 tons as compared with 1918. For purposes of comparison the following table is shown:—

	Est. 1919.	1918.	1917.	1916.	1915.	1914.
Coal, gross..... tons, 2,240 lb.	2,504,423	2,578,724	2,398,715	2,485,580	1,972,580	2,166,428
Less made into coke..... "	147,205	276,479	248,740	401,487	361,451	355,461
Coal, net..... "	2,357,218	2,302,245	2,149,975	2,084,093	1,611,129	1,810,967
Coke made..... "	98,598	188,967	159,905	267,725	245,871	234,577

In these figures for 1919 the output for the month of December has had to be estimated, consequently the final figures may vary from them slightly.

Summarizing the Provincial production of coal, the following table shows the estimated output for 1919:—

	Tons of 2,240 Lb.
From Vancouver Island collieries	1,690,724
From Nicola and Similkameen collieries	152,731
From Crowsnest District collieries	659,408
From Telkwa collieries	1,560
Total quantity coal mined	2,504,423
<i>Less made into coke</i>	<i>147,205</i>
Net quantity of coal produced	2,357,218

In addition to the above net production of coal, there was made the coke production shown in the following table:—

	Tons of 2,240 Lb.
From Vancouver Island collieries	43,517
From Nicola and Similkameen collieries	<i>Nil.</i>
From Crowsnest District collieries	55,081
Total	98,598

As will be seen by the above figures, the net coal production this year is expected to be some 54,973 tons (2,240 lb.) more than it was in 1918.

Coke.—The production of coke in 1919 was about 98,598 tons (2,240 lb.), which is 90,360 tons less than the preceding year, a decrease of about 48 per cent.

The coal-mines of the Province have had a fairly good year. Interruptions to production were as follows: A strike at Fernie closed the mines during June, July, and August, but work was started again the beginning of September. During the months of May, June, and July the mines on Vancouver island worked on slack time, losing probably 160,000 tons that might have been produced.

VANCOUVER ISLAND COLLIERIES.

The Vancouver Island collieries made a gross output of about 1,690,724 tons of coal, or 24,513 tons more than 1918.

Canadian Western Fuel Co.—This company mined this past year about 641,171 tons of coal, a decrease from the previous year of 90,751 tons.

The Nanaimo Colliery, in the City of Nanaimo, is entered by No. 1 or Esplanade shaft, which is connected by underground workings with a shaft on Protection island and also on Newcastle island. The workings are at a depth of from 600 to 1,200 feet, and are very extensive, including a large submarine area. On the North side both the Douglas and Newcastle seams are operated; on the South side only the Douglas or Upper seam is worked. This property has been in operation since 1881, and is still the largest producing coal-mine in the Province.

The Reserve Colliery is situated about five miles from Nanaimo; the Douglas seam is reached through two shafts 950 feet in depth. This property became a producer in 1914; development has been retarded owing to faulted and much-disturbed condition of the seam.

The Harewood mine, which has been closed down for a number of years, was reopened during 1917, and at the present time is producing about 1,000 tons daily.

The Wakesiah shafts, which were sunk during 1918 on the Five-acre Lots, are now producing 200 tons daily.

Canadian Collieries (Dunsmuir), Ltd.—This company operates two collieries—Comox Colliery, situated at Cumberland, seventy miles north of Nanaimo, and Wellington-Extension Colliery at Extension, six miles south-west of Nanaimo.

The mines of the Comox Colliery are situated around Cumberland and are connected by a standard-gauge railway with the seaboard at Union bay, where are situated the loading-piers, a coal-washery, and a battery of 200 coke-ovens.

The mines operated during the year were Nos. 4 and 7 slopes and No. 5 shaft. No. 6 shaft, however, has not been producing coal during the year.

The estimated gross output of coal for this colliery during the year is 549,513 tons (2,240 lb.), an increase of 11,147 tons over 1918.

The mines of the Wellington-Extension Colliery are situated around Extension, and are connected by a standard-gauge railway with tide-water, and the Esquimalt & Nanaimo Railway at Ladysmith, where a coal-washery, bunkers, and loading-piers are situated.

Three mines were operated during the year, Nos. 1, 2, and 3, entered by a tunnel 5,000 feet in length. The output for the year was about 224,498 tons, practically the same as produced in 1918.

The new slope known as No. 5 mine is being developed at South Wellington, from which the output for the year was about 86,118 tons, an increase of 57,331 tons over 1918.

Pacific Coast Coal Mines, Ltd.—This company operated the Morden mine throughout the year; the mine is situated about six miles south of Nanaimo and produced about 64,147 tons during 1919, a decrease of 18,482 tons from 1918 production.

The Suquash Colliery, situated on the north-eastern coast of Vancouver island and owned by this company, was not in operation during the year.

British Columbia Coal Mining Co.—The output for the past year was about 36,739 tons, an increase of 22,671 tons over 1918 production.

Nanoose Collieries, Ltd.—This colliery is situated at Nanoose bay, about ten miles north of Nanaimo, and is operating in the Old Wellington seam. The output for this colliery during the past year was 20,803 tons, a decrease of 8,001 tons from the previous year.

Granby Colliery No. 1.—The new colliery of the Granby Company at Cassidy Siding produced about 67,735 tons of coal during the year, an increase of 50,777 tons over 1918 production.

NICOLA-SIMILKAMEEN COALFIELDS.

These coalfields produced in 1919 about 152,731 tons, a decrease from the previous year of 26,448 tons.

In the Nicola District four companies produced coal during 1919—viz., the Middlesboro Collieries, Limited, the Fleming Coal Company, the Merritt Collieries, and the Coalmont Collieries.

The Middlesboro Colliery produced about 81,589 tons during the year, a decrease of 19,970 tons under the previous year. The mines in operation were Nos. 4, 4 East, 7, and 8.

The Fleming Coal Company operated the Coal Hill mine during the year. The production for this colliery was about 37,127 tons, an increase over the previous year of 3,924 tons.

At Princeton the Princeton Coal and Land Company produced about 22,966 tons, a decrease of 15,707 tons from the previous year.

The Coalmont Collieries produced 10,012 tons and the Merritt Collieries produced 1,037 tons.

EAST KOOTENAY COALFIELD.

There were only two companies producing in this field during 1919—the Crow's Nest Pass Coal Company, operating collieries at Coal Creek, situated five miles east of Fernie, and Michel, situated twenty-three miles north-east of Fernie; and the Corbin Coal and Coke Company, with its colliery at Corbin.

There was mined in the district during the year 659,408 tons of coal, a decrease of 73,456 tons from the previous year.

Of this tonnage, about 9,074 tons was used to make coke and yielded about 55,081 tons of coke; as compared with the 1918 output these figures show a decrease of about 108,999 tons of coke produced.

The mines which were in operation throughout the year at Coal Creek Colliery were No. 1 North, No. 1 South, No. 1 East, B North, and Nos. 2 and 3; the largest producing mine at the present time being No. 1 East. This produced approximately 305,623 tons, or 96,840 tons less than in 1918.

Production in the Crowsnest District was curtailed by a strike during June, July, and August.

Michel Colliery had three mines in operation throughout the year—viz., No. 3 East, New No. 8, and Old No. 3 mine, which was reopened during the summer. This colliery produced approximately 171,977 tons, or 34,435 tons less than in 1918.

Corbin Coal and Coke Co.—The output of this company for the year was approximately 81,807 tons, being a decrease of 42,182 tons from the previous year. The major portion of this production was from the open-cut workings of No. 3 mine, or "Big Showing." No. 4 mine was also in operation during the year.

NORTHERN COALFIELD.

Telkwa Collieries Co.—Late in the fall of 1918 production on a small scale was started by this company. The colliery is situated four miles and a half from Telkwa, a town on the Grand Trunk Pacific Railway. About 1,560 tons was mined and shipped to Prince Rupert, and a continued production is expected. This is an increase of 1,090 tons over 1918.

MINING DISTRICTS OF BRITISH COLUMBIA.

NORTH-WESTERN MINERAL SURVEY DISTRICT No. 1.

PRELIMINARY REPORT BY G. A. CLOTHIER, RESIDENT ENGINEER.
(Headquarters, Prince Rupert.)

INTRODUCTORY.

District No. 1, comprised of eight Mining Divisions of the Province—viz., Bella Coola, Skeena, Queen Charlotte, Nass River, Portland Canal, Stikine, Atlin, and Liard—includes all the coast from the head of Vancouver island north to Portland inlet and from Portland inlet north to the northern boundary of the Province east of the Alaska strip.

It has been pointed out in former reports that this district has many natural advantages and all the favourable geological features for prospecting and mine-operating. I would, however, like to again call the attention of the prospector to the immense field open to him along the coast, on the islands, and from the head of Portland canal north, along the eastern contact of the Coast granite with the Interior sedimentaries, to the Stikine river, and north of that, on the same belt, through to the Atlin country. The coast and islands, as can readily be seen on the map, are easily accessible at any point. The "eastern contact belt," from the head of Portland canal north, gives great promise of becoming a great mineral-producing area, judging from those portions of it that have been developed to any extent—the Salmon and Bear Rivers sections, the Anyox section, and the Alice Arm section. The southern portion of this belt is reached from Stewart, B.C., either by way of the Salmon River valley over the Salmon River glacier or the Long Lake glacier, or by way of the Bear River valley over the Bear River divide on the Bear-Nass trail, which extends through to Meziadin lake. The northern portion is accessible by way of the Stikine river, on which the Barrington Transportation Company runs a weekly boat from Wrangell to Telegraph Creek, commencing about May 15th.

All that part of the country along the Stikine, from a point about seven miles up from the Boundary or where the Iskut river flows in from the south, to the Clearwater, flowing in from the north, should be as good a prospecting country as there is in the Province. North from the Stikine the Clearwater is navigable for small boats by poling and lining for probably thirty miles, thus making fairly accessible a big area of this mineralized belt. South of the Stikine the Iskut river is navigable for forty miles paralleling the Coast range and all in the "eastern contact belt," making an additional stretch of country easily reached and never prospected. The head of the Unuk river, which has for years been known to carry high-grade minerals, is accessible by way of that river for small boats by poling and lining.

If all probability prospectors' trails will be put into that belt this coming year by the Government from the Stikine and Iskut rivers south, following the South branch of the Iskut, north from some point on the Bear-Nass trail over the Bear River divide, and over the Salmon River and Long Lake glaciers, thus assuring definite and serviceable routes to facilitate the prospector in his work of extending the known mineral-producing area.

THE MINING SITUATION.

This has, I think, been the crucial year for mining in this north country, for the reason that, of the many properties bonded this spring on which development has been done all summer and is, on many, being continued this winter, the majority are turning out well and warranting further extensive exploration. Also, several sections of the district have been thoroughly investigated by the most competent mining engineers in the profession, resulting in the investment of a great deal of capital for interests in proven properties, as well as for working bonds on promising prospects to be opened up next year.

This has been a year of extraordinary activity, and if present conditions are any criterion, the outlook for next year and the future is decidedly promising.

In the Salmon River section at the head of Portland canal, and the Kitsault River section at the head of Alice arm, this activity has reached almost "boom" proportions. Fortunately,

the majority of the properties bonded in the spring were to companies sufficiently strong financially to carry on the necessary development-work, and therefore the general public has not, to any extent, been invited to "take a chance." It may be expected, however, that next year will see the small operator and promoter take advantage of the generally favourable condition of the mining situation, and the public will then have a chance to "get in" on properties stocked for that purpose.

The following is a list of the shipping properties and their approximate outputs for the year:—

Name of Property.	Location.	Tonnage.	Gold.	Silver.	Copper.
Atlin (placers).....	Atlin.....	.....	\$ 175,000	.....	.....
Stikine and Liard (placers).....	Telegraph Creek.....	.....	14,000	.....	.....
Shuttle Island (placer).....	Lockeport.....	.....	700	.....	.....
			Oz.	Oz.	Lb.
Granby Con. M. S. & P. Co.....	Anyox.....	655,427	11,100	425,111	20,000,000
Dolly Varden.....	Alice arm.....	6,373	.....	400,336	.....
La Rose Mine.....	Alice arm.....	20	2	5,000	.....
Premier Gold Mining Co.....	Stewart.....	490	3,194	108,285	.....
Ikeda Mines, Ltd.....	Ikeda bay.....	165	54	800	43,700
Shuttle Island (quartz).....	Lockeport.....	.....	18	.....	.....
Belmont-Surf Inlet Mines, Ltd.....	Surf inlet.....	103,451	45,367	28,283	653,243
Drum Lummon Copper Mines, Ltd....	Hartley bay.....	16	10	402	17,442

While this year's actual production will fall short of that of last year, due to the lessened output of the Granby Company at Anyox, whose plant was closed down a portion of the year, it cannot, by any means, be taken as an indication of the falling-off of the mining industry. Had the Granby Company output been normal, then the increase of production for the district for the year would have been the output of the Premier Gold Mining Company, the Dolly Varden Mines Company, and the increase of output of the Surf Inlet Mines, the total amounting to, approximately, 7,000 oz. gold, 510,000 oz. silver, and 220,000 lb. copper, or nearly \$750,000. The total gold and silver production of the district for this year will show an increase; the latter metal will be doubled, due to the shipments from the *Dolly Varden*.

The following is a brief review of the mining situation in District No. 1, under the headings of the different Mining Divisions:—

Bella Coola Mining Division.

I have been unable, on account of lack of time, to get over any part of this Division this year. However, there has been very little mining activity outside of the staking of several claims and the usual assessments.

Queen Charlotte Mining Division.

I visited the islands early in the spring, and regret that I have not been able to get over again this fall to check up the season's work. Further authentic information will be contained in my later annual report.

The Ikeda Mines, Limited, situated on the bay of the same name, has been under operation all year and shipped a small tonnage of sorted copper ore to the Anyox smelter.

I understand that efforts are being made by the manager, A. Ikeda, to interest Japanese capital to the extent of installing a concentrator for the treatment of the ores. There are several thousand tons of second-class ore on the dump, besides that exposed in the mine-workings, and many surface showings on the company's claims that might be opened up to advantage if there was a concentrator for these lower-grade ores.

The output for this year has been as follows: 165 tons shipped, returning 54 oz. gold, 800 oz. silver, and 43,700 lb. copper. The gold and silver values are about the same as last year, but the copper has fallen off about 20,000 lb.

The South Easter Mining Company, which has been operating about a mile back from Skidegate, closed down early in the spring and has not yet resumed, though I am informed that it is the intention of the company to proceed with deeper development-work.

There is a splendid showing of milling-grade gold ore on the surface, but sinking and drifting has shown that this ore-shoot does not extend down more than about 50 feet, below which the vein-filling is decomposed and the vein itself more or less displaced.

The *Producer* group, formerly the *Lucky Seven*, owned by Thompson & McKinnon, has been under bond to Seattle interests, who have done a lot of exploratory work this summer. A small compressor plant was installed and a crosscut run from the surface to tap the vein exposed above, on which a shaft had been sunk 50 feet, disclosing some good-grade copper-sulphide ore. Some trouble was encountered in locating the vein in this crosscut, and I have no late information as to the results of this work.

On Copper island, just outside Jedway harbour, A. Heino has been working on his claims all summer and has taken out several tons of chalcopyrite ore for shipment.

On Shuttle island, about seven miles below Lockeport, the owners of the *Ellen* claim have been working all summer open-cutting and sinking. They have taken out from this work about \$350 in free gold by mortaring and panning. The gold is found in small, irregular quartz stringers in the sedimentary formation.

The *Ticksey* placer claim on the beach of Shuttle island has also been worked by the owner, J. Hendricks. Some 53 oz. of placer gold was washed out and sent to the Government Assay Office, and the owner had probably \$300 or \$400 besides that in nuggets. So far it has been worked by loading the beach-gravel on a small scow and towing it around the upper end of the island and across to the main Moresby island to a small creek where the gravel is sluiced and the gold obtained. The owner will put in a small plant to enable him to wash the gravel on the ground instead of hauling it half a mile to water. The short length of beach and the consequent small amount of gravel is not sufficient to make it of great importance.

I have, as yet, no information as to progress made on the beach placer claims on the north and east coasts of Graham island. There has been some little staking of coal and oil claims on the west coast of Graham island.

Skeena Mining Division.

The Belmont-Surf Inlet Mines, Limited, at Surf inlet, on the west coast of Princess Royal island, has made a very substantial increase in its output over last year. This year's tonnage amounts to 103,451 (an increase of nearly 6,000 tons over last year), concentrated to 9,472 tons shipped to Tacoma and yielding approximately 45,367 oz. gold, 28,283 oz. silver, and 653,243 lb. copper, an increase of about 8 per cent. in gold and about 50 per cent. in copper. A more detailed report on the workings and operations will be given in the yearly report.

The Drum Lummon Copper Mines, Limited, has extensive holdings on Miskatlah bay, on the north shore of Douglas channel, about twenty-five miles from Hartley bay. This company operated all season up to the very cold weather, when the mill had to be closed. Underground development-work will be continued throughout the winter. About 50 feet of drifting on the vein has been done since the last report, with some crosscutting and drifting on side-veins and some stoping of ore for mill-feed. The mill was remodelled to some extent, the Gibson type table being replaced by a couple of small jigs and a flotation unit added. Grinding is done by two Gibson mills, taking their feed direct from the crusher, but their capacity and product is totally inadequate and unsuited to the present milling process. About 16 tons of high-grade copper ore was produced, yielding 10 oz. gold, 402 oz. silver, and 17,442 lb. copper. With a well-located, properly designed mill on this property it would go far towards paying for the extensive development necessary to prove the property's worth.

Ecstall River.—Further exploration by diamond-drilling was continued throughout the summer by the Granby Consolidated Mining, Smelting, and Power Company, to which the property has been under bond for the past year or more. No information is available as to the results of this work.

The smaller islands, Porcher, Gibson, etc., have had no active mining other than yearly assessments.

This also applies to the country contiguous to the Grand Trunk Pacific Railway as far as Terrace. I have not had time to again get into the Kitsumgallum Lake section, nor Thornhill mountain, across the Skeena river from Terrace, but I am informed that all the properties mentioned in last year's report have had at least the yearly assessment done and in some cases

additional development. A trail six miles long was built by the owners of the *Blue Grouse* and *Hunter* groups, with assistance from the Mines Department, from Cedar River Crossing north to their claims.

The many claims on Thornhill mountain have also had the yearly assessment done. No other activity is reported.

Nass River Mining Division.

This Division has had a year of remarkable growth of the mining industry. The *Dolly Varden*, situated on the Kitsault river about eighteen miles from the town of Alice Arm, has at last been added to the list of shippers, and has made a most enviable record for the short time it has been shipping. This has established the necessary confidence in this section, with the result that there are very few properties in the valley that are not being developed or under option. The situation at present gives one every reason to believe that next year will see the greatest mining activity yet seen in a quartz camp in northern British Columbia. The completion of the *Dolly Varden* railroad from tide-water to the mine, eighteen miles, places that portion of the valley practically on tide-water and guarantees transportation for the remaining eight to ten miles. This feature, together with the many extraordinary mineral-showings in the "silver belt," surely justify a very optimistic outlook for the future.

The Granby Consolidated Mining, Smelting, and Power Company, Limited, operating at Anyox, has, unfortunately, been producing only a portion of the year. The plant was closed down for a couple of months, which, with the lessened production until operations were in full swing again, materially cut down the year's output. The quantity of their *Hidden Creek* ores smelted during the year will amount to approximately 655,000 tons, yielding about 11,100 oz. gold, 430,000 oz. silver, and 20,000,000 lb. copper. For fluxing purposes 41,000 tons of limestone was used and 36,000 tons of quartz. This shows a falling-off of about 9,000,000 lb. of copper from last year, but an increase of gold and silver, probably due to the contents of the fluxing quartz. The experimental concentrating plant has been operating all year. The coke and by-product plant is now under operation, coke being made from the coal from the company's coalfields at Cassidy, on Vancouver island. The company has employed an average of 1,350 men and paid out about \$2,350,000 in wages during the year.

The Taylor Engineering Company, operating what was formerly the *Dolly Varden* Mines, Limited, property, situated eighteen miles up the Kitsault river from Alice Arm, has made a remarkable production when the condition of the mine affairs, when taken over, is taken into consideration. This year's operations were commenced in July, and much credit is due A. W. Davis, who has been in charge of the work, for the results obtained.

About two miles of the railroad from the beach to the mine was completed; a steam-driven power plant installed at the end of steel and air-line from it to the mine; a 2-bucket tramway with terminal bunkers constructed; camps erected at the end of steel and at the mine; and the mine was put in shape for stoping and shipping.

By the end of November, or five months from the time work was started, 6,373 tons of ore had been shipped that will yield approximately 400,336 oz. silver; about 40 tons of this was bonanza ore.

It was found inadvisable to attempt to operate the railroad during the winter months; consequently, it was closed early in December and ore shipments ceased. The mine is being developed all winter.

The *North Star Frac.* has been under option to Jas. McAleenan, of Alice Arm, for over a year, during which time the property has been opened up to such an extent that regular shipments can be made. This year a tunnel was started about 90 feet below the one on which the work was done last year and driven over 100 feet. The vein was picked up 20 feet from the portal and drifted on continuously from that point. The first 50 feet of the vein is low-grade quartz, but the balance of it is in shipping-ore.

At the time I examined the property, about September 1st, the shipping-ore had been drifted on for 70 feet. The vein had just crossed diagonally through a small dyke and the face showed 4 feet of high-grade ore. There were 20 or 30 tons on the lower dump that were later shipped to Granby, from which no returns have been received as yet. Mr. McAleenan has since rebonded the property to other parties.

The *Toric* group has had the tunnel on the main vein, described in 1918 Annual Report, extended to 20 feet. The vein now shows 4 feet of ore; then 8 feet of a horse; then 5 feet of well-mineralized vein to foot-wall. A good showing.

The *Tiger* group, owned by Ed. Pickett, has been bonded to interests represented by Mr. Price. At the time of my visit to the property no new work had been done. The present bondor is driving a tunnel on the upper end of the vein where the surface indications were the most promising, but I have no information as to results obtained from this work.

The *Musketeer* group, owned by Miles Donald and Al Miner, of Alice Arm, is now under option to A. D. Meenach, of Seattle. Considerable work has been done this year by way of open-cutting across the vein in several places. From information thus obtained a tunnel was started, crosscutting about 30 feet to the vein and then drifting on the ore. Some very fine ore was disclosed in the surface cuts, showing ruby and native silver, and I understand that the ore drifted on in the tunnel is very encouraging. Work will be continued throughout the winter.

The *Silver Horde* group, owned by Al Miner and A. Davidson, has had no work but the yearly assessment.

The *Climax* group, which consists of two claims situated adjoining the *Silver Horde* and *Moose* groups, is now owned equally by M. Oleson, of Alice Arm, and O. Bisner, of Prince Rupert. A great deal of surface prospecting-work has been done during the summer, consisting of a number of open-cuts along the side-hill for the purpose of tracing the vein from the *Moose* ground (above) down the hill. The work has certainly improved the possibilities of the property, though the ore exposed in the cuts is yet low grade. Drifting on the exposures of ore will give good depth and an improvement in values may be expected from such work.

A trail was started this season by the Government from the main trail up over this property to serve also the *Moose*, *Last Chance*, and other properties up Trout creek; this will be continued next year.

The *Moose* group is owned by Don Cameron and associates. It was under option at the time of my visit to the section this summer and no work was being done on it. I am informed that the option was not exercised and that the owners are now driving a crosscut tunnel to intersect the vein as exposed on the surface. The result of this work will be watched with interest, as the surface showing of high-grade ore is an exceptionally good one.

The *Last Chance* group is situated on Trout creek about a mile from the main Kitsault trail and above the *Moose* and *Climax* groups. It is owned by McPhail, Kolbeck & Morley, old-timers of Alice Arm and the north country, and is now under bond to Mr. Price. The work being done consists of diamond-drilling, the results of which, I understand, have so far been satisfactory. This property has probably the largest surface exposure in this section, and its exploration, therefore, will be of especial interest to the local property-owners.

There are several claims and groups located beyond the *Last Chance*, farther up Trout creek and across from the head of Trout creek, in the Green Lake section. Some fine samples of ore have been brought in from these locations and next year will no doubt see sufficient work done to show their importance.

The *Second Thought* group has had nothing done on it since last reported on, but I think that some work was done later. Further information will be available for the yearly report.

The *War Eagle*, *Black Diamond*, and *Columbia* groups all had the yearly assessments done on them.

The *Homestake* group, owned by Davidson, Pearson & Smith, situated on the west bank of the Kitsault river opposite the glacier, has had no work done on it this year other than having been surveyed for Crown grant. The property was bonded early in the year to Mr. Somerville and associates, who have incorporated a company and will proceed with work as soon as possible in the spring. The same company has purchased the *Matilda*, *Tip Top*, and *Fox* claims above and adjoining the *Homestake* group.

The *Vanguard* group, owned by Morris Peterson and Strombeck Bros., had some further development done by the owners. Assistance was given by the Mines Department for a trail from the main Kitsault trail to the workings on the property.

The *Wildcat* group is owned by Davidson & Macey and situated on the west side of the Kitsault river above the Homestake Creek bridge. The work done this year consists of a short assessment-tunnel run in on one of the upper croppings.

The *Copper Cliff*, opposite Trout creek, on the west side of the Kitsault river, also had assessment-work performed.

The *Ruby* group, owned by T. Shackelton, is now under bond to J. C. Smith, who had four men working on the property all summer. The group is composed of two claims—*Ruby* and *North Star Frac.*—situated on the east side of the Kitsault river opposite the *Dolly Varden*. The showing consists of a shear-zone in the greenstone formation, about 15 feet wide on the surface, carrying pyrite and a little galena in the more siliceous portions. A tunnel had been driven 35 feet from a point lower down the hill, toward getting under the cropping. I have been later informed that the ore was encountered and the showing favourable.

The *La Rose* group has been worked all summer by the owners, who have taken out over 20 tons of high-grade ore. A shaft was sunk 14 feet and the ore drifted on both ways from it and extracted up to the surface. The ore shipped this year from which returns have been received amounts to 20 tons, yielding 2 oz. gold and 5,000 oz. silver, with also a little lead. The last shipment, recently sent to the Trail smelter, is expected to be the best grade yet shipped. A crosscut tunnel driven in from below to gain some depth on the vein might make this a very profitable little property.

Henderson's claims, situated on the railroad just below Spring camp, had not sufficient work done on them to show up anything of importance.

The *Central* group consists of three claims—*Central*, *Homeguard*, and *Traveller*—owned by "Red" McFarlane and Dan Kennedy. They are situated on the east bank of the Kitsault, fourteen miles from tide-water. A cable and cage furnish transportation across the river.

The showing, at an elevation of 400 feet above the river, is an open-cut across 20 feet of ore composed of a brecciated country-rock of andesite cemented together with calcite, which is heavily mineralized with pyrite and chalcopyrite. A sample across a 5-foot section of this gave 3.9 per cent. copper, 6 oz. silver, and \$2.40 gold; and another across 8 feet gave assays of 3.5 per cent. copper, 2.4 oz. silver, and 60c. gold a ton. Diamond-drill holes proved this to be a huge boulder of ore 30 feet or more in thickness. About 50 feet above this is another immense boulder of the same material, while 75 feet above this again a tunnel has been driven for a length of 30 feet through another one, coming out into big boulders of country-rock. At an elevation of 1,275 feet a tunnel 130 feet long has been driven by the owners, of which 118 feet is in loose slide-rock and the balance in the solid andesite country-rock. At the mouth of this tunnel the first 20 feet of it was through a boulder of ore. No more boulders of ore have been found on the surface above this tunnel. From the fact that these huge masses of ore lie on the surface it would appear that they were the last to have been broken from some point above. A crosscut from the end of the long tunnel might be successful in locating this vein, which must be a large one. I judge from the mineral content of the ore that it would concentrate from 5 to 7 into 1 and make probably a 10-per-cent. copper concentrate. The values in this ore and the evident size of the vein makes this a good gamble to try to find it in-place.

The *Esperanza* group is situated about half a mile from Alice Arm, on the west side of the Kitsault river, and is owned by Salina Bros., Vaughan & Luffgren. This property has been shipping a small tonnage for the past eight or ten years, except for the last year. One of the Salina Bros. has been doing a little work this summer, and succeeded in opening up another shoot of high-grade ore which will be mined and shipped by him. The ore is a quartz, carrying high silver values in argentite, ruby and native silver, occurring in the slate formation of the lower Kitsault and conforming with the bedding-planes of the slate.

The *Independent* group, owned by Archie McPhail and situated just above the town of Alice Arm, was under option to D. J. Hancock, who did considerable work last winter and during this summer. The tunnel was extended to 240 feet, getting under the surface showing exposed in a shaft. The vein occurs in the slates and is exceptionally well defined and continuous, but no values of any importance have been found, except a small stringer on the foot-wall in the shaft.

The *War Dance* group is comprised of six mineral claims—*War Dance*, *Grouse No. 3*, *Betsy*, *Bute*, *Whistler*, and *Badger*. The claims are owned by A. McGuire and situated about seven miles from Alice Arm, up the North-east fork of the Kitsault river. There is a good foot-trail all the way which could be converted into a pack-trail with the expenditure of a few hundred dollars. There is a good cabin on the property at an elevation of 700 feet above the west bank of the river. The showings consist of a number of quartz veins, carrying pyrite, chalcopyrite, zinc, and galena, lying in sedimentary country-rock. A little work has been done by way of

open-cuts and stripping, disclosing well-defined, rather flat veins. The values are low, but no depth has been obtained at any place yet. This section of the country deserves investigation.

The *Mother Lode* and *Silver Bar*, on the east side of the river, have had a little surface work done, exposing a quartz vein from 2 to 4 feet in width, but it will take further work to prove its value.

The *Waverley*, *Kitty*, and *Maxwell* claims have been staked on a big quartz vein which, as yet, is unprospected.

There has been considerable activity in the Illiance River section. The Government did a lot of work on the trail, which was probably one of the worst in the Province, and it is now in first-class condition up to 11-Mile, and I understand will be completed next year. There are a number of small, high-grade veins in this section that will pay the owners to work and send the ore down by pack-horses; therefore a first-class trail is an absolute necessity to encourage the opening-up of that area.

The United Metals Mining Company has employed from six to eight men all summer and done considerable development-work. A number of pack-horses was taken in early in the spring for packing the ore from the mine to the beach and supplies up to the camp. For various reasons very little ore was brought down, but with the trail in good condition for next season and the available tonnage of ore claimed by the management, there should be no further delay in shipping.

There are a number of small veins on the property, from which small bunches of ore have been taken from the surface, but no persistent effort has been made to gain any depth from which drifting could be done on these veins. The largest and most continuous showing appears to be the one just behind the cabin; this has been open-cut for a length of 35 feet and has now a face about 7 feet high, in which there is about 18 inches of good ore. A crosscut tunnel from the creek of about 150 feet would give a depth under this vein of approximately 90 feet, and a drift on the vein, if found at this depth, might make the property worth something. Gophering out little bunches of ore from here and there on the surface is useless. About 27 feet of a tunnel towards the "Cabin vein" has been driven, but this work was discontinued. Several veins parallel to the "Cabin vein" would no doubt be crossed in this tunnel, and these could also be drifted on and opened up if warranted. The property is under the management of D. J. Hancock.

Silver Star Group.—There are two claims in this group, situated across the Illiance river from the property of the United Metals Mining Company. They are now owned by Hodgson & Bone, who had considerable work done on the property this summer, showing it up to very good advantage. The vein was crosscut from a point where it cropped in the face of a bluff, and here shown to have a width of 12 feet of fine milling-grade ore, with streaks of very high-grade ore through it. The chief mineral is galena, and there are small bunches, veinlets, of grey-copper which assay very high in silver, samples running up to \$1,900 to the ton. A drift was run from the end of the crosscut along the hanging-wall for 20 feet, with good ore all the way. It was the intention to continue this drift for 30 feet and then crosscut the vein again, back to the foot-wall or towards the bluff. This is a very promising-looking property and with hand-sorting will no doubt produce quite a tonnage of high-grade ore.

Monarch Group.—No more work has been done on this property since last reported on, other than tracing the vein farther north on the surface. This work was done by W. B. Bower, one of the owners, who spent some time on the ground this summer. There is an excellent surface showing on this property, under which a tunnel has been driven, but failed to locate the downward extension of the vein. I think that a little careful work from the tunnel would pick up the vein and prove the property a valuable one.

Silver Bell Group.—Work was being done on this group by two of the owners, Joe Hayes and W. J. Bradley. The property was thoroughly described in the last year's report and little further has since been done.

The annual assessment-work was done on several other claims in this section.

Portland Canal Mining Division.

This Division has had a year of unprecedented activity and progress, and, with the start it has made this summer, even greater results may be expected for next year. The majority of the older and better-known prospects were bonded last winter or very early in the spring,

and on account of the lateness of the season in this section no supplies could be taken in until in June, and in some cases it was July before any work could be started; consequently the amount of work done in this, the first year, has been comparatively small, but very encouraging. As conditions permitted, examinations were made of other prospects, with the result that many were optioned and, where possible, work started. Also there was a great deal of prospecting done and many new finds made that will be investigated the coming year, all pointing to a year of extraordinary activity in 1920.

Work was carried on all summer on the road from the beach to the *Premier* mine and will be completed next year by the Alaska Government into a first-class wagon-road to the Boundary. This road will in all probability be continued by the Provincial Government as a sleigh-road to the head of the Salmon River valley and improved from year to year into a good highway. A road has also been built by the Provincial Government connecting this Salmon River road with Stewart, so that there is now direct road communication from Stewart to the *Premier* mine. The new dock to have been built at Stewart this year has not yet materialized. It is badly needed.

None of the properties on Portland canal proper have had any work done on them this year, the only active spot being at Swamp point, where the Granby Company procures its supply of limestone for the smelter at Anyox. The normal production is about 250 tons a day, hauled to Anyox on the company's scows. The average number of men employed is about thirty.

Several options have been taken on properties in the Bear River valley, on which work will be commenced as early in the spring as possible.

The *Prince John* group consists of nine claims and is owned by Jas. Nesbitt and Andy Archie. The property is situated about five miles up the valley from Stewart, on the west bank of Bear river. There is a big body of low-grade copper ore lying in slate which has been exposed by a crosscut tunnel. No further work has been done on this since the last yearly report.

At the time of my visit to the property the owners were doing some surface stripping on another parallel vein down the hill from the big showing. Only a few shots had been put in it, but it appeared to be a strong quartz vein, well mineralized with pyrite and showing some chalcopyrite. I consider this property well worth investigation as a low-grade copper proposition.

Bayview Claims.—There are two claims of this name—*Bayview No. 1* and *Bayview No. 2*—situated just above the town of Stewart at an elevation of about 4,000 feet. They are owned by Geo. Cameron and W. C. Cameron, of Stewart. A couple of small open-cuts disclose a small quartz vein carrying galena and grey-copper, making high-grade ore in places. The property has been bonded this fall to Everett interests, who will open it up in the spring.

George Copper-mines.—This property consists of ten claims owned by the George Bros. and situated on the south bank of Bear river, about six miles from the upper terminus of the Portland Canal Short Line Railway. This year's work was all done on the "Blue vein" in open-cutting and stripping. The work has proved it to be better than the surface would indicate, and it now gives promise of developing into a big vein of good-grade copper ore. It is a big property with so many places that should be opened up that the yearly work done by the owners does not make much of a showing. The "White vein," wherever broken into, shows a good width of solid chalcopyrite ore, 8 feet in a couple of places, and since it has been traced for 2,000 feet on the surface it alone has the possibilities of a big mine.

The tunnel being driven under the big ore-zone was extended another 5 feet this year, and the face now looks better than ever before, showing seams of solid pyrite, with considerable magnetite and hematite, all carrying traces of chalcopyrite. Altogether the property shows an improvement over last year and credit is due the owners for the amount of work done.

I have just received information that the property has been recently bonded, and that the bond calls for extensive development-work to be started in the spring as soon as weather conditions will permit. If adequate capital is forthcoming to open up this property on the scale it demands, I look for it to become one of the big copper-producers of the Province.

The *Red Top* group, consisting of fourteen claims owned by J. McNeill and J. J. Connors, is situated on the north side of Bear river about opposite the *George* mines. There is a fair trail to the camp breaking off the main Bear-Nass River trail at a point about half a mile beyond the bridge that crosses the Bear river above the *George* cabin. From that point it is

about two miles and a half to the property. The first showing is at an elevation of 2,550 feet, opened up by an open-cut giving a face about 15 feet high and showing a width of 15 feet of mineralized, decomposed, and broken-up slaty-looking material. The vein strikes east and west into the hill and dips about 60 degrees north. The hanging-wall is well defined and is a coarse-grained igneous rock. At an elevation of 2,600 feet further stripping and open-cutting has been done, and the vein has been pretty thoroughly stripped between the two cuts. Beyond the second cut a great deal of surface work has been done which has succeeded in getting through the heavily oxidized surface in a few places, exposing bands and bunches of quartz well mineralized with chalcopryrite. There does not appear to be any definite strike to the mineralization in these upper exposures. The property was bonded some time ago, but no work was done on it this year.

The old *Lucky Frenchman* group beyond the *Red Top* claims, on which work of some extent was done in early days and had since lapsed, has been restaked this summer.

Mountain Boy Group.—This group of mineral claims includes the *Mountain Boy*, *American Girl*, *Northern Belle*, and *Hard Money*, situated on the west side of American creek, about five miles from the end of the railroad at the *Red Cliff*. The camp is at an elevation of 1,200 feet on a small hill or "island" in the middle of the valley. The tunnel is at an elevation of 2,000 feet, reached by a switchback trail from the camp. There is a good trail from the main Bear River wagon-road to the *Mountain Boy* cabin, but it has been little used for the past few years and is badly overgrown. A few hundred dollars would put it in good repair again.

The country-rock is a reddish-coloured, medium-grained porphyry, probably red andesite. The vein on the surface is well defined, with a width of from 16 to 18 feet, and consists of quartz and calcite heavily mineralized with zinc, and some galena. It has a strike at the portal of the tunnel of about S. 50° W. into the hill and dips at an angle of from 50 to 60 degrees south-east. The tunnel followed the vein for about 30 feet from the portal, when it ran off into the foot-wall; it was then turned to the left and enters the vein again at about 60 feet beyond. At this point a crosscut to the left shows the ore to be 28 feet wide. A peculiar feature is seen in the tunnel where numerous intrusions of country-rock cut the vein, leaving open crevices and cracks running in all directions. This condition does not appear to disturb the vein to any extent, as is seen in its continuation in the crosscut just mentioned. I did not have time to sample the ore, but the vein is a big well-defined one and an immense tonnage could be developed if the values were sufficient for mill-feed. Not being familiar with the property, this was the only workings I saw, but I understand that there is a tunnel on the *Hard Money* claim showing about 10 feet of the same class of ore, and another showing on the *Northern Belle* claim about 18 feet wide. I consider this property well worth a thorough examination.

The *Independent* group is owned by Sam and Jack Fitzgerald, of Stewart, and comprises six claims—*Independent* and *Independent Nos. 1, 2, 3, 4, and 5*. The group is situated at the head of Goose creek, on the Bear River slope, and is reached by trail from the railroad up Goose creek to the camp, at an elevation of 2,700 feet. An open-cut at 3,300 feet elevation exposes a vein having a width of 14 feet, striking N. 75° W. and dipping at 65 degrees to the south. In the centre of this 14 feet there is 4½ feet of heavily pyritized siliceous rock also carrying some galena and zinc, in which the principal values are in silver, with a little gold. Along one side of this quartz portion of the vein is a small basic dyke about a foot wide, while on both sides of the quartz and dyke is a somewhat less siliceous, dioritic-looking rock heavily pyritized and containing bands and veinlets of quartz. Another cut 50 feet south of this shows silicification with pyrite and chalcopryrite; the intervening rock is too heavily overburdened to be examined. The owners claim that it again crops 1,000 feet farther up the hill. No samples were taken. The property is under option to Mr. Meloche.

Jutland Group.—This group is comprised of two claims—*Jutland No. 2* and *Jutland No. 3*—and is owned by Cowan, Watkins & McInnis. The group is situated at the head of the North fork of Bitter creek, eighteen miles from Stewart and nine miles from the railroad at the mouth of Bitter creek, being two miles and a half from the *Roosevelt* group at the forks of Bitter creek. There has been a good trail up Bitter creek as far as the *Roosevelt*, but it is in places in need of repairs. From the *Roosevelt* the owners of the *Jutland* group last summer put in a foot-trail to their camp. A good route and grade was selected for this and it could easily be improved into a horse-trail. The camp is at the foot of the glacier at an elevation of 2,300 feet. On the

right-hand side of the glacier, at an elevation of 3,200 feet, there is a showing of quartz and decomposed material about 18 inches wide, in which there is a streak of high-grade galena ore up to 8 inches wide, the best of which gives assays of over 200 oz. silver to the ton. There is considerable grey-copper in this galena, which accounts for the high values in silver. Enough work has not been done here to show anything. Farther along the glacier, on the same side, is another small vein of high grade lying on the foot-wall of a band of schistose slaty rock which is enclosed in the andesite country-rock. No work has been done on it.

The *St. Elmo* group, owned by the same men, has four claims—*St. Elmo*, *St. Elmo No. 2*, *St. Elmo No. 3*, and *St. Elmo No. 4*. These are situated on the opposite or west side of the glacier and have showings of the same class of high-grade ore as the *Jutland* claims. The formation in this immediate section appears to be badly twisted and folded andesite, in which can be seen intrusions of other igneous rocks and enclosures of small bands and bunches of sedimentaries. These small veins, when opened up, may produce high-grade ore in sufficient quantities to make them profitable for small operations.

The *Gibson* group consists of four claims owned by H. D. Gibson and partners and is situated south of the Portland Canal Mining Company's claims on the Bear River slope. The first showing on these claims is at an elevation of 3,900 feet, where the cropping shows a vein about 6 feet wide of heavily oxidized and decomposed quartz, in which are remaining ribs of quartz carrying pyrite, galena, and zinc-blende. No work has been done, but, from the width of the vein and the mineralization, I should judge that it would be well worth while to get a little depth on it. The rock formation is argillite. About 400 feet east of this and a little lower down the hill is another vein of the same character. Still farther east is a big cropping of hard, flinty quartz mineralized with arsenopyrite, in which a couple of open-cuts have been driven. Fair gold values are reported from this vein.

The *Sunshine* group is situated on the north side of the North fork of Glacier creek. There are three claims in the group—*Sunshine*, owned by Godfrey Anderson; *Sunshine No. 1*, owned by Fred Young; and *Morning Star*, owned by Dan Woodmore. They are about five miles by a good trail from the railroad at the Portland Canal Mining Company's siding. About a mile of tramway would land ore at the bridge on the *Ben Bolt* trail, about three miles from the railroad siding.

The cabin on the claims is at an elevation of 3,200 feet, or about 200 feet above the shore-line of the glacier. There is plenty of timber for all purposes and ample water-power could be developed in Glacier creek just below the glacier. The rock formation is of igneous origin, probably a greenish-coloured andesite, in which are intrusions of other igneous rocks and belts of argillite.

There are four or five veins on the property; two high-grade silver veins just below the cabin near the glacier, striking N. 30° W. or nearly parallel with the glacier, and one quartz vein mineralized with pyrite and chalcopyrite on the *Sunshine* claim. On the *Morning Star* are two more quartz veins also mineralized with pyrite and chalcopyrite. A few tons of high-grade shipping-ore was taken from the two small veins, but they are unimportant, since there is no chance for any appreciable tonnage.

The pyritized quartz vein on the *Sunshine* claim has been exposed in one place above the cabin by a few shots put in on the surface, showing the vein at this point to be at least 3 feet wide of chalcopyrite ore that will assay about 6 per cent. copper. Below the cabin it has been broken into in several places, the upper of these showings being about 8 feet wide, in which there is about 3 feet that will assay 10 per cent. copper. This is a fine showing of ore and deserving of more work. Below this there are bunches of ore scattered across a width of 100 feet, indicating that the vein is broken up into stringers.

On the *Morning Star* claim another well-defined vein strikes N. 40° E. and dips at 40 degrees to the south-east. It is exposed for some distance on the sloping side of a ridge, and above that appears to lie under a belt of diorite. A depth of 5 feet has been obtained on it at one point, showing a well-mineralized width of 2 feet on the hanging-wall of pyritized quartz and calcite carrying considerable chalcopyrite; the balance is not so well mineralized. This is a big strong vein and deserves opening up.

Another big vein of quartz has been found lower down the hill; it strikes at right angles to the one just mentioned and is about 14 feet wide, but seemingly of lower grade than the other. This is a good-looking property for any one wanting copper.

L. & L. Group.—This lies on the opposite side of the glacier from the *Sunshine* group and is owned by Jack Lockwood and partner. It consists of three claims—*L. & L. No. 1*, *L. & L. No. 2*, and *Marion Frac.* There is a first-class horse-trail to the property, breaking off the *Ben Bolt* trail. The showing consists of a quartz vein of from a few inches up 4 feet in width, lying in an igneous rock formation. The vein has been stripped at intervals for a distance of 300 feet or more on the surface from the portal of the tunnel. There is very little ore in the first 150 feet, but from that point, so far as opened up, a nice ore-shoot has been exposed. A tunnel has been driven about 125 feet on the vein, which shows the same in the tunnel as on the surface, except that it has not been driven far enough to catch the ore-shoot. This shoot no doubt rakes into the hill a little, so that the tunnel will have to be driven beyond a point vertically under the beginning of the shoot. The ore is galena and zinc carrying high silver values contained in grey-copper. A ton of ore sorted and shipped a few years ago assayed 273 oz. in silver to the ton.

The *Evening Sun* and *Columbia* claims are located on the Middle fork of Glacier creek, on the trail up to the *L. & L.* group, and are owned by W. W. Rush. These are old locations and have had considerable work done on them. A few tons of ore has been shipped in past years, taken principally from surface croppings.

At an elevation of 2,500 feet on the *Evening Sun* claim a tunnel has been driven about 90 feet on a well-defined vein standing vertically and striking into the hill at N. 30° E. Some high-grade ore was extracted from an open-cut about 30 feet above this tunnel, but apparently it was a surface shoot, as the tunnel has not found it yet. The vein appears to be an altered country-rock of igneous origin, with more or less siderite on the walls, through which are small veinlets and bunches of antimony and zinc sulphides carrying, in places, grey-copper with consequent high silver values.

Across the gulch, on the *Columbia* claim, what appears to be the continuation of this vein has also had some work done on it and some ore taken from the surface. Tunnels run under these high-grade croppings have proven them to be small lenticular bodies.

The *Excelsior* and *Eagle* claims, owned by A. Boggs, are situated on the top of the ridge between the Middle and South forks of Glacier creek. They are reached by a prospector's trail from Rush's cabin on the South fork. The predominant formation is igneous rock, cut by many dykes running in a north-west and south-east direction, and has been badly fractured judging from the network of small quartz veins seen everywhere. Striking from N. 20° E. to N. 50° E. are a number of small veins of light-grey rock throughout which are small veinlets of antimony, zinc, and grey-copper ore, while, as a rule, along one wall there will be from 4 to 12 inches of siderite and quartz carrying high values in silver in grey-copper, with a little galena and more zinc. What is considered the main vein has a width up to 6 feet, strikes N. 20° E., and dips at about 50 degrees to the north-west. This has been opened up in several places, showing a high-grade streak on the wall of from 4 to 12 inches in width. Enough high-grade ore could probably be sorted out to make it profitable if there was a trail from the *Ben Bolt* trail to the top of the hill.

The *Lakeview* group of four claims is situated on the North fork of Glacier creek. The property is under bond to Fetter, Welsh & Carlton, of Seattle. Camps were being erected at the time of my trip and no new work had been done since my last annual report. Later information will be given in this year's report. A crew of men is working all winter on the property under the management of Al Harris, who is also in charge of the *Mineral Hill* for the same people.

MARMOT RIVER.

Up the Marmot river there are several properties that have been held for some years and from which small shipments of high-grade ore have been sent out from time to time. This section is very accessible by way of a good trail following up the river. It is about two miles and a half from the beach to the forks of the river and a further three miles to the foot of the glacier, which has an elevation of 1,375 feet. The hills on either side of the river are very high and break off abruptly in straight cliffs. At certain times of the year, when the snow is running in the spring, there would be some danger from snowslides in places, but in the summer it is one of the most accessible areas in the district.

The *Montana* group consists of nine claims owned by Bruggy & Magee and is one of the first locations on the river. The showing is a quartz vein up to 2 feet wide contained in a solid

granite formation, which is a spur thrust up through the surrounding igneous rocks. The vein, carrying high silver values in grey-copper with considerable galena, has been traced for about 800 feet on the surface. It has been opened up in several places and several shipments of high-grade ore made by hand-sorting the ore taken from these cuts. The vein strikes north-west and south-east and dips at a flat angle of about 25 degrees to the north-west. There is a crosscut tunnel about 60 feet long tapping the vein, and drifts running both ways, from which some fine ore was extracted. At the point where the crosscut hit the vein a winze was sunk some 30 feet on the vein. It was full of water, but I was informed by one of the owners that there is a good showing of ore all the way down. The tunnel is about 1,000 feet above the level of the valley, and at present it is rather hard to reach owing to high water having washed out the trail, which followed up a small creek. No difficulty would be found in getting a trail up from the river, and a short tramway could easily be erected to bring ore down and supplies up.

The *Horseshoe* claim, one of the *Montana* group, is reached by good going around over the glacier; there are several croppings of ore, but they are not opened up sufficiently to permit of any opinion being formed as to their importance.

A number of claims have been staked in this section this year. The North fork of the Marmot runs into the main river about two miles and a half from the beach. There is a very fair trail from Fraser's cabin at the forks up to the North Fork basin.

The *Fraser* group has seven claims in it and is owned by W. Fraser, of Stewart. It is situated on the east side of the North fork of Marmot, about three miles up. The rock formation on this group appears to be a big mass of igneous rock, altered and pyritized throughout, with veins of solid pyrrhotite and small quartz veins traversing it in all directions. These quartz veins carry gold and silver values, but it would be almost impossible to find them, as the whole area, for a width of probably 1,000 feet, is heavily oxidized to a red and yellow colour. About the only feasible way to prospect it would be by diamond-drilling. It is an immense area of oxidization and worth investigating.

The *North Fork Basin* claim is situated beyond the *Fraser* group. It and the *Crawford* claim, lying below the *Fraser* group along the glacier, are owned by Fraser, Woods & Magee. The formation here is schistose, as it is below the *Fraser* group. A tunnel has been driven for 200 feet along a well-defined slip to get under a shaft that was sunk above it from the surface and in which was some high-grade ore. No ore has been found in the tunnel.

SALMON RIVER SECTION.

The Salmon River section has this year had a geological survey made of it by the Canadian Geological Survey under the direction of J. J. O'Neill. This valuable report will be available within the coming year.

There are a number of properties working all winter in the valley, and, judging from the number bonded and the number of new companies being put on the market, there will be a season of far greater activity in mining next year than this has been.

The *International* group, situated just over the Boundary-line above 11-Mile, was under bond to Pat Daly and associates. A crosscut tunnel was started at an elevation of 2,275 feet and driven 90 feet towards getting under the surface showing. It is estimated that a 300-foot tunnel would have a depth of 160 feet vertically under the vein. For some reason the work was closed down early in the summer.

The Premier Gold Mining Company, Limited, has had a busy summer on outside work. The wagon-road from the beach to the mine has had a crew steadily on it all season and is now an excellent sleigh-road. It will be improved into a wagon-road next season.

A camp for teamsters was erected at 9-Mile as a half-way house between the mine and the beach, and accommodations made for teams, supplies, etc.

Camps were also built at the upper or working tunnel for this winter for the accommodation of a hundred men, and one at the mouth of the Plate tunnel that will accommodate forty men. At the mouth of No. 1 tunnel a new blacksmith-shop was built. The ore-bunkers were remodelled and a new frame building put on them to be used for crushing, sorting, and sacking ore. At the camp a new four-story bunk-house was built, a two-story mess-house, a two-story office, and an assay office. At the mouth of the Plate tunnel a three-story bunk-house, a two-story mess-house, a blacksmith-shop, timber-shed, compressor building, and an extension of 80 feet on the snow-

shed were built. Very little work was done in the mine, consisting mainly in the driving of the upper or No. 1 tunnel about 200 feet, No. 5 crosscut for 68 feet, No. 6 crosscut for 6 feet, and No. 7 crosscut for 20 feet. In No. 2 tunnel No. 1 crosscut was driven 215 feet. The work outlined for this winter includes the driving of the Plate tunnel, crosscutting and raising, and further work in No. 2 tunnel, and the production of all possible tonnage from No. 1 tunnel.

Bush Mines, Ltd.—This property is situated about a mile above or farther up the valley from the *Premier*. A very creditable amount of work has been done this summer; camps were erected in the spring and a crew of eight to ten put on the surface opening up the showings. Two open-cuts were run across a mineralized belt apparently having a width of about 100 feet. These cuts show that there are possibilities of ore-shoots on the foot and hanging walls, with very little in between. On the hanging-wall there is about 6 feet of altered greenstones containing small stringers and patches of high-grade silver sulphides, the whole averaging low grade. Two tunnels were driven on this showing at intervals of about 20 feet below the open-cut. The first tunnel found the hanging-wall, on which there are a few inches of good-grade ore. The lower tunnel had not found any ore at the time of my examination. Some 200 or 300 feet down the creek from this another tunnel was being driven, then in about 130 feet, in country-rock all the way.

B.C. Silver Mines, Ltd.—This company has recently been incorporated for \$1,500,000 by O. B. Bush, and has taken over the *Lake* and *O'Leary* claims, lying between the *Premier* ground and the *Bush Mines, Limited*, and some claims north of the *International*.

The *Spider* group of three claims belonging to Bill Hamilton and Charlie Larsen, of Stewart, is situated north of Long lake. The group was bonded early in the spring to Trites & Woods, owners of the *Premier* mine, who did some development-work, but did not exercise their option, the property reverting to the owners. Some very high-grade silver ore was found in a small vein, but not enough work was done to prove anything. The claims are now under option to W. A. Meloche, who will commence operations as soon as possible in the spring.

All that country from the *Bush Mines, Limited*, north to the *Spider* claims, have been staked this summer.

Some fine specimens of high-grade silver ore were brought in from some claims that had been staked over the glacier from Long lake, on the Nass River slope. The stakers returned, built a cabin, and are putting in the winter working on their claims.

Mineral Hill Group.—This property has been under bond and development for the past two years, during which time very extensive work has been done under the supervision of Al Harris. There are several fine showings of high-grade ore on the surface, under which several hundred feet of underground work has been done. The results have not been what were hoped for, so far as high-grade ore is concerned, but the development of milling-grade tonnage is a different proposition. The property is under bond to Welch, Fetter, Carlton, and associates, of Seattle.

Big Missouri Group.—A number of open-cuts were put in last year on two claims of this group adjoining the *Mineral Hill* group—the *E Pluribus* and the *Laura*. The property was taken over by Sir D. D. Mann and work commenced early this spring. Several more open-cuts were made, disclosing very high-grade ore, and diamond-drilling was decided upon as the best method of prospecting. A tunnel was also started and driven about 30 feet towards getting under the high-grade ore exposed in the open-cuts. This tunnel is now being continued this winter. Nine or ten diamond-drill holes were drilled during the summer, some of them giving very satisfactory results. Drilling will be resumed in the spring on the immense showings on the other claims. The *Big Missouri* has been examined by many engineers, and the general conclusions drawn have been that, with the proper metallurgical process for the ore, it would make one of the biggest producers in the country.

The *Unicorn* group lies east of the upper claims of the *Big Missouri* group. Unfortunately I did not get on the ground until the season's work had been finished, so I did not know where all the work had been done. However, I saw three or four of the open-cuts and all showed good-looking ore. I am informed that the bondors are very well satisfied with the results of the season's work and would have continued the work all winter if they had had time to get camps up before the snow came.

The *Sunset* group, north of the *Unicorn*, has been bonded to Vancouver interests, who will commence work as early as possible.

The *Montana* group, lying between the *Unicorn* and the *49* group, has also been optioned recently to Eastern people.

49 Group.—This property consists of nine claims and has been under bond since last spring to Sam Silverman and associates. Taking into consideration its location and the difficulties of transportation, a good season's work has been done on it. A fine camp was built, all lumber and materials being packed on horses from the beach, about twenty-five miles.

Diamond-drilling was contracted for and the machine put on the ground, but with inadequate power, resulting in the season being wasted so far as obtaining any information from drilling was concerned.

A tunnel is being driven diagonally across the main ore-showing on the *49* claim, which looks as if it were going to develop a big tonnage of a fine grade of milling-ore as well as shoots of high grade. A new vein on the *Occidental* claim is also being explored by a tunnel that is now in about 50 feet (October 17th), showing, all the way, from 1 to 3 feet of shipping-ore. There is a big surface showing beyond the *49* tunnel that has never been broken into yet and which may develop a big tonnage of at least milling-grade ore.

Prospectors have been exploring that country past the *49* group and claim there is the same mineralization all the way. Many claims were staked in there this summer and all that country across the glacier, where accessible, has been staked.

Pay Roll Group.—These claims were bonded early in the spring and some work done on them, which evidently was disappointing.

Several new companies have been formed already and claims and groups are being sold every day; consequently it is impossible to keep track of the standing of the different sections of the district.

Stikine and Liard Mining Divisions.

I made a trip into the Dease Lake section this summer, going in about July 1st by way of Telegraph Creek, from which point it is seventy-two miles to the upper end of Dease lake. Of this distance, about twenty-five miles has been improved into a wagon-road, the balance being a first-class trail that could easily be converted into a sleigh-road by cutting down the grades in a few places. There were two pack-trains running from Telegraph Creek, each making the round trip to Dease lake and return in ten days, thus making a train every five days. Packing from Telegraph Creek to the lake costs 7 cents a pound, and down the lake, a distance of twenty-eight miles, the Hudson's Bay Company, operating a freight-scow, charge 1 cent a pound to Porter's Landing at the foot of the lake.

I picked up an old book of accounts at Laketon, an old placer camp on the lake at the mouth of Dease creek; it was dated 1878, and it was an interesting comparison of prices of such commodities as whisky, flour, bacon, etc., with present-day prices.

The only mining activity of any account was on Thibert creek, which empties into Dease lake at its lower end, at Porter's Landing. The Thibert Creek Mining Company had operated a hydraulic plant on this creek for a number of years, up to a couple of years ago, when the project was abandoned. Geo. Adams, an Atlin operator, secured a bond on the ground and plant and resumed work this spring under very unfavourable conditions. He repaired the flume and cleaned off a considerable area of old bed-rock that had been buried under a mud-slide, in order to move the sluices up to an advantageous position. He then cleaned up some bed-rock that had been partially cleaned by the old company and which, he was given to believe, would yield good returns. He was badly disappointed in getting only about 40 oz., but decided to open a new pit on his own judgment of the lay of the bed-rock. This work took twenty-two days, and in that time the clean-up was about \$14,000. He is planning extensive repairs and improvements and will go at it next year on a much larger scale.

Some leases on Deloire creek, a tributary of Thibert creek, have been purchased and the ground is being tested this winter by drilling.

I look for quite a revival of interest in that section, and next year will probably see increased activity.

On my return trip down the Stikine I stopped off at Clearwater river and went up ten miles to Jackson's camp. Several thousand dollars were taken out of one spot some years ago, giving one reason to think that the four or five miles of river-bars and benches on this river are worth

testing. The river is navigable for thirty or forty miles up from the mouth by poling and lining, and all that country along the river and west to the eastern contact should hold wonderful possibilities for the prospector.

I also went up the Iskut river, a tributary of the Stikine, flowing into it about six miles above the Boundary, for a distance of thirty-six miles and examined some claims that have been held for years. I found some showings of copper and galena, but there has been no work done to open them up; consequently it is difficult to form any opinion of them. The rock formations are identical with other portions of the eastern contact belt and should be equally as good for prospecting. If the Iskut channel was cleared so that the Stikine River boats could run with any degree of safety, it would open up an immense country for exploring.

Atlin Mining Division.

I am informed by Mr. Fraser, Gold Commissioner at Atlin, that this has been the dullest year in mining since the camp started. This condition is due to the lack of labour and the increased cost of producing gold.

The total placer yield for the year will be approximately \$175,000, compared with \$218,000 last year.

NORTH-EASTERN MINERAL SURVEY DISTRICT, No. 2.

PRELIMINARY REPORT BY JOHN D. GALLOWAY, RESIDENT ENGINEER.

(Headquarters, Hazelton.)

GENERAL REMARKS.

During the year 1919 the North-eastern District progressed favourably in mining development, and the total production is expected to have been nearly as large as that of the previous year. The actual production of placer gold will show a slight decrease as compared with 1918, but placer development has been active in the Cariboo and Quesnel Divisions. The output of silver, lead, and zinc for the district is mostly made by the *Silver Standard* mine at Hazelton. This mine has had a satisfactory year, with about the same production as in 1918. The copper production will be considerably lower this year than in previous years owing to the *Rocher Déboulé* mine having been closed down all year.

A small production of coal, amounting to about 1,500 tons, was made by the Telkwa Collieries.

The following figures give the estimated output for the year 1919 and the corresponding figures for 1918:—

	1918.	1919.
Placer gold (oz.)	4,400	4,000
Lode gold (oz.)	985	200
Silver (oz.)	84,125	90,000
Lead (lb.)	123,568	100,000
Copper (lb.)	643,843	12,000
Zinc (lb.)	313,112	300,000
Coal (tons)	470	1,560
Miscellaneous (dollars)	7,400	7,000

While the production of the North-eastern Mineral Survey District for the year 1919 does not show any increase over that of 1918, nevertheless, considered as a whole, mining activity for the year was satisfactory. This district is as yet in the prospect or development stage; no real development was possible until the Grand Trunk Pacific Railway was completed in 1914, and although since that time several properties have been brought to the shipping stage, the district as a whole has not progressed as fast as might have been expected. Many reasons could be given for this, chiefly that during the war labour and financial conditions were not conducive to the opening-up of a new country.

During the last year a considerable change has taken place in the country, and it is particularly noticeable in the way in which settlers are taking up the land. This increase of population will no doubt add to the prospecting carried on in the country, as well as gradually improving the wagon-road transportation.

There are in the North-eastern District hundreds of claims in the prospect stage, many of which warrant more extensive examination and development than has yet been given to them. While the war was on but little attention was paid to these by examining engineers, but gradually

many of these properties are being investigated. The counter-attraction of a decided "boom" in the Stewart country to some extent prevented the North-eastern District securing the attention it might have had in 1919.

Generally, however, the outlook for the future is promising, and a steady growth in mining development and production may be expected in the future.

It is very encouraging to be able to report that, whereas gold-mining and production seems to be on the decline in many parts of the world, in the Cariboo District the outlook for the future, due to present activity, is satisfactory.

For some years past placer-mining in the district has been confined to half a dozen hydraulic outfits and a few individuals working in a small way.

During the seasons of 1918 and 1919 a number of prospective placer enterprises were considerably advanced; so much so that some of them now give promise of soon reaching the productive stage. Of these enterprises, the proposed installation of a dredge on Antler creek is a most important one. The area to be dredged is owned by Moore and associates, and has been thoroughly tested by Keystone-drilling. There is a considerable yardage available for dredging, in which the values are much higher than is usually obtained in dredging-ground.

Other placer propositions are being equipped with a scraper-dredge system of dredging, and one of this type was in operation during the season at Harpers camp.

The amount of placer-work being carried on by drifting is comparatively slight, but shows an increase during the past season. Most of this work is exploratory, as, for instance, on Antler, Jack of Clubs, and other creeks. The *Kitchener* mine on Keithley creek had a highly satisfactory season, as some rich ground was struck in a portion of the old bench-channel.

The most important event in the Cariboo Division in 1919 was the commencement of active development of the gold-quartz properties on Proserpine mountain near Barkerville. If, as is expected, the development proves satisfactory, a new era of mining will be opened up in the Cariboo, and quartz-mining will receive attention in a district where it has been popularly supposed the only possibilities were in placer-mining. The groups of claims now being tested are typical of many quartz-showings in the district, and if these prove successful others undoubtedly will be developed.

Another important development in the Cariboo District during the season was the commencement of the testing of the placer-gravels at Harpers camp. The prospecting of this area by Keystone-drilling has been under consideration by the Mines Department for some time past, and about the end of November the work was begun.

Omineca Mining Division.

SKEENA SECTION.

The town of Usk, situated 100 miles east of Prince Rupert, on the Grand Trunk Pacific Railway, was the centre of considerable mining during the season of 1918.

The Kitsalas Copper Company continued its work of development and equipping the *Cordillera* mine. The ore on this property consists of bornite, with which is associated good gold values, occurring in quartz. The main vein has been developed by an incline shaft and a crosscut tunnel 400 feet long. In the fall of the year development of a blind vein encountered in the crosscut tunnel was commenced, and it is reported that the ore-showings are most encouraging. In the summer the erection of a small concentrating-mill was started, but the work was delayed owing to non-delivery of machinery, due to strikes, etc. This mill consists of a jaw-crusher, Gibson mill (for grinding), and a Wilfley table. It is expected that it will be in operation by the end of the year.

Kleanza Co.—During the summer this company was organized for the purpose of entering into lumbering and mining at Usk. The company is developing a hydro-electric plant on Kleanza creek and is erecting a large sawmill.

The *Golden Crown* group, formerly owned by Wells & Durham, was acquired by the Kleanza Company, and a crew of men was kept constantly at work during the summer and fall. The main work done was stripping the two quartz veins that occur on the property. These veins, which carry values in gold and copper, have been exposed for considerable distances and are reported to be showing up well. It is proposed to further develop these veins by means of drift-tunnels, but this work will not be started until power is obtainable from the power plant now in course of erection.

The Kleanza Company is a strong organization, most of the capital coming from North Dakota. John Willman is the manager at Usk. The *Golden Crown* group is situated on Kleanza creek, three miles from Usk, and was described by W. M. Brewer in the 1914 Annual Report of the Minister of Mines.

Kleanza Creek.

There are a number of claims at the head of Kleanza creek which have considerable showings of copper ore (see 1914 and 1917 Annual Reports of the Minister of Mines). Of these, the *Peerless* group was further developed during the summer by the owners, O. T. Findland and partners, with satisfactory results.

The trail up Kleanza creek to these claims is about twenty miles in length from Usk, and at the present time is in a very bad condition. Substantial improvements will be made to the transportation to this camp by the Government next season, and it is expected that considerable activity will result.

Legate Creek.

About a dozen prospectors were at work during the season on their claims at the head of Legate creek. Orr & Lenhart worked the *M. & K.* group, and in the fall shipped 30 tons of high-grade copper-silver ore. This shipment went to the Anyox smelter, and is expected to run from 20 to 25 per cent. copper and 20 to 30 oz. silver to the ton.

Other properties that were further developed this year were the *Regina*, *Independence*, *Snowslide*, and *Bell* groups.

This camp is situated twelve miles from Pacific, a divisional point on the Grand Trunk Pacific Railway. A good trail runs up Legate creek to the forks of the creek, and from this point branch trails go to the different claims.

The values in the ore in this camp are mainly in copper and silver, with in some cases appreciable amounts of lead. As a rule the galena found in the ore carries good silver values, and when grey-copper is present high silver values are obtained.

HAZELTON SECTION.

In this section the only producing mine during the season was the *Silver Standard*, as the *Rocher Déboulé*, a former big shipper, remained closed all year. This latter property is a copper-mine, and apparently the management considered it good policy to wait for a better copper market. At the present time the mine has a considerable amount of milling-ore proven, but no shipping-ore is available until further development is undertaken.

If the property was equipped with a small concentrator and a comprehensive development plan laid out, there seems to be no reason why this mine should not repay further exploitation. Probably this policy will be adopted in the near future.

Delta Copper Co.—The holdings of this company comprise the *Delta* and other groups of claims and a control of the stock in the company owning the *Highland Boy* group. The showings, development-work, etc., have been fully described in previous annual reports.

In the winter of 1918 to 1919 a crosscut tunnel was started on the *Delta*, but after driving about 100 feet the work was stopped and nothing further has since been done. Apparently the delay in continuing vigorous development of this property has been due to the inability of the company to finance such work. However, it is believed that this condition is now changed, and it has been announced that work will commence early in 1920. W. G. Norrie-Lowenthal has been retained as consulting engineer, and under his direction the work will be commenced in a short time. The property undoubtedly has merit, and it seems probable that in a short time it will enter the shipping class.

Silver Standard.—This mine was reopened in April after having been closed down from December, 1918. The main reason for closing down last winter was the inability to satisfactorily market the silver-lead and silver-zinc concentrates. Conditions, however, are now such that continued operation may be expected. By the end of October about 3,000 tons of ore had been treated in the mill, from which were produced 390 tons of silver-zinc concentrates and 128 tons of silver-lead concentrates. The lead concentrates carry about 225 oz. silver to the ton and 35 per cent. lead, and the zinc concentrates about 120 oz. silver and 35 per cent. zinc.

Development during the year has been satisfactory. The No. 4 vein now has a continuous ore-shoot of over 400 feet in length. During the year ore was steadily stoped from the main vein, but a considerable tonnage is still in reserve, which can be augmented by further develop-

ment. The No. 1 vein was stripped on the surface and a good shoot of ore 200 to 300 feet in length was uncovered. Generally the mine is in good shape, and undoubtedly with further deep development the nine veins on the property will yield a large tonnage of ore.

The mill now treats about 25 tons of ore a day. The crusher and jigs are run one 8-hour shift and the tables two 8-hour shifts. The mill is now running pretty well, but a high extraction cannot be expected in a water-concentrator running on a quartzose ore containing galena, zinc-blende, and grey-copper.

The management is at present considering the advisability of remodelling the mill and putting in an oil-flotation plant to treat the tailings, which would result in a much improved extraction. At the same time a deep-level tunnel will be driven to crosscut the vein system at some depth below the present workings. This tunnel will be about 1,000 feet in length. For the present the mill will be kept running, but before long a decision may be made to remodel the mill this winter so as to have everything in readiness for large-scale production next summer.

TELKWA SECTION.

Hudson Bay Mountain.

During the year 1919 there has been more activity in mining on Hudson Bay mountain than in previous years. While no production is recorded, it is expected, as a result of the work inaugurated this year, that a considerable production may be made next year.

Early in the year the Skeena Mining and Milling Company was organized to develop the *Victory* and *Coronado* groups of mineral claims, situated on the southern slope of Hudson Bay mountain and distant about twelve miles from the town of Smithers. The company started operations in the spring, but stopped work during most of the summer. A start was made again in October, and it is expected work will be continued all winter.

The *Victory* group is owned by Donald Simpson, who has worked the property intermittently during the last ten years, and who has shipped in all about 50 tons of ore. The ore consists of galena and zinc-blende occurring in a gangue of siliceous rock.

The Skeena Company immediately after acquiring the properties purchased the machinery for an hydro-electric power plant and for a 50-ton water-concentrating mill. This mill is of the Faust type and supplied by the Faust Concentrator Company, of Vancouver.

In October the *Mamie* group, owned by J. Aldrich and situated close to the *Victory* group, was bonded by J. Turner and work on the property commenced. This property has a good strong vein mineralized with zinc-blende, arsenical iron, and in places a little galena. The development will consist of a drift-tunnel on the vein.

Silver Creek Group.—Schufer & Woods continued development of the *Silver Creek* group on the north-eastern side of Hudson Bay mountain. The 30-ton shipment made from the property in 1918 was concentrated at the *Silver Standard* mill in June, and the ore averaged about \$175 a ton gross in all values. The construction of a new trail to this property was started this year and it will be finished next season. When this is completed transportation to this side of Hudson Bay mountain will be greatly improved.

Babine Range.

Babine Bonanza Co.—On this property, better known as "Cronin's mine," a long crosscut tunnel was started this year and work on it is being continued all winter. This property has been intermittently developed for the last ten years, and there is now a considerable tonnage of silver-lead-zinc ore proven. It is hoped that when the new crosscut tunnel, which is intended to be driven about 1,000 feet, strikes the ore-body a sufficient tonnage of ore will be developed to warrant the erection of a concentrating-mill. The property is connected by a sleigh-road with the town of Telkwa, a distance of thirty miles.

Other Properties.—P. J. Higgins carried on further development this year on his Driftwood Creek showings—the *Silver King* group—and on the *Victoria* group. On the former there is a quartz vein carrying in places grey-copper with high silver values, while the *Victoria* group has silver-lead ore.

A new trail was built up Driftwood creek this year to connect the *Social* group, owned by McPhee & McCabe, with the wagon-road. This trail serves a number of properties in this section, and as it is a well-graded trail it materially improves the transportation into this part of the Babine range.

BURNS LAKE SECTION.

The *Silver Fox* claim, owned by P. Anderson, has been bonded by the Taltapin Mining Company. The property is situated twenty-three miles from Burns lake towards Babine lake. The company started operations late in the fall, and has now built twelve miles of sleigh-road connecting the property with Burns lake and put up camp buildings; eighteen men are at work, and a drift-tunnel, with three shifts at work, is being run.

The main vein on the property is exposed in a canyon on 15-Mile creek; it is said to be 8 feet wide, half of which is high-grade ore and the balance milling-ore. Some very high assays have been obtained; the ore is a mixture of galena, grey-copper, pyrite, and chalcopryite, occurring in a quartz gangue. The company will develop the property all winter, and expects to put a mill on the ground in the spring.

Cariboo Mining Division.

It is gratifying to be able to report a material advancement in mining in the old Cariboo District. The production from this district up to the present time has been almost entirely placer gold, but the development of mineral claims now taking place gives a fair promise of lode-mineral production in the near future. A considerable revival of interest is also taking place in placer-mining, and a number of new properties have been taken up and are being equipped with plants.

BARKERVILLE SECTION.

The largest producer is the group of three mines—*Lochee*, *Mosquito Creek*, and *Stouts Gulch*—which are controlled by John Hopp. Other hydraulic properties in this section which have been operated are the *Point* mine on Slough creek, Sparks & Felker on Perkins gulch, *Waverly* mine on Grouse creek, and a number of individuals on different creeks working on a small scale.

The supply of water during the hydraulic season was normal and better than in 1918. The yardage handled was in most cases quite satisfactory, but was somewhat lower grade than in previous years. But for this the gold production would have shown an increase over 1918.

PROSERPINE MOUNTAIN.

The most important event in the district in 1919 was the commencement of active development of the gold-quartz properties on Proserpine mountain near Barkerville. If, as is expected, the development proves satisfactory, a new era of mining will be opened up in the Cariboo, and quartz-mining will receive attention in a district where it has been popularly supposed the only possibilities were in placer-mining. The groups of claims now being tested are typical of many quartz-showings in the district, and if these prove successful others undoubtedly will be developed.

The showings on these properties are quartz veins varying in width from a few feet up to 20 feet and carrying small quantities of pyrite, arsenical pyrites, and smaller amounts of galena. The main valuable metal content is gold which is apparently associated with the iron sulphides. The distribution of the gold values is quite irregular, and much development will be required to determine the average gold tenor of the veins as a whole or in workable portions of the veins. It is apparent that when any considerable body of the quartz is considered the average gold value will be low, but it is expected that it will prove sufficient to mine and mill on a large scale and still leave a margin of profit. In other words, a large low-grade mine is the possibility for these properties.

The groups that have been bonded are the Armstrong & Tregillus properties, situated on Proserpine mountain, five miles from Barkerville. The properties have been taken up by Robert A. Bryce, of Toronto, who is backed by a syndicate of Toronto capitalists. Mr. Bryce secured the claims in September and immediately commenced operations. The claims were surveyed and camp buildings erected. The plan of development includes surface work, several drift-tunnels, and one or more shafts. In addition, two diamond-drills will be in operation in a short time. At present about seventy men are employed.

The terms arranged were in the nature of a lease and bond extending over some years, with a small cash payment and progressive payments as the time goes on.

QUESNEL SECTION.

Lightning Creek Gold Gravels and Drainage Co.—Construction, repair-work, and Keystone-drilling were carried on by this company during the spring and summer of 1919. In the fall a

new shaft was started. This shaft will be sunk through the stream-gravels and is for the purpose of opening up the deep channel of Lightning creek, where drilling has shown good gold values on bed-rock. Shafts have been sunk on this property before, but have been lost owing to the heavy water-pressure. The plant is now well equipped with pumps to handle a very large flow of water, and it is hoped that this shaft will be successful in reaching the channel. Work is progressing during the winter.

Placer Mines, Ltd.—The property of this company is situated on the Fraser river twelve miles below Quesnel and near the mouth of Kersley creek. The ground to be worked is a bench of the Fraser river. James F. Reilly is manager in charge of the work. Equipment of the property with a Sauerman scraper was commenced during the summer, eleven men being employed for three months. Work was stopped in the fall.

During the year a company was organized by S. J. Marsh to work gravel-deposits on the Quesnel river ten miles above Quesnel. It is intended to work the ground by the use of a scraper, and the necessary machinery has been bought, but not yet delivered. The work of equipping the property will be commenced in the spring of 1920.

Quesnel Mining Division.

KEITHLEY SECTION.

R. W. Harrison continued operating the *Kitchener* placer mine with a small crew of men. This is a drifting proposition, and during the season a rich part of the channel was struck, with the result that considerable gold was taken out, the season's clean-up being more satisfactory than formerly.

Harpers Camp.

The International Dredging Company operated its plant, consisting of a drag-line scraper, during the season, but as yet the ground being worked is mainly on old tailings, so that but little returns could be expected.

The prospecting of this area by Keystone-drilling has been under consideration by the Mines Department for some time past, and about the end of November the work was commenced. It is expected that, if the weather permits, drilling will be continued most of the winter.

A full report on the Harpers Camp area and the proposed Keystone-drilling of the ground can be found in the Annual Report of the Minister of Mines, 1918, pages 136 *et seq.*

To sum up briefly: A small area lying in bend of the Horsefly river at Harpers camp was very rich placer-ground, having produced from \$500,000 to \$1,000,000. The character of the gold found here showed that it had travelled some distance. It is therefore maintained by many that the small rich area at this point must necessarily have a feeding channel coming into it.

A certain amount of prospecting by means of hand-sunk shafts has been done in attempts to find a continuation of the rich ground, but without success. For such prospecting Keystone-drilling is the most satisfactory method. The work to be done this winter by the Government will be of great assistance to the International Dredging Company in outlining the pay areas in their ground. If the drilling is successful in finding a feeding channel it will mean a great deal to the Harpers Camp area.

CENTRAL MINERAL SURVEY DISTRICT, No. 3.

PRELIMINARY REPORT BY R. W. THOMSON, RESIDENT ENGINEER.

(Headquarters, Kamloops.)

INTRODUCTION.

Although the Central Mineral Survey District covers an area of approximately 45,000 square miles, the mineral-output up to the present time has not been in proportion to its area as compared with the other districts of the Province. This condition may be largely accounted for by reason of lack of transportation facilities.

A considerable portion of the area comprising District No. 3 is covered by what is termed, physiographically, the Interior plateau, consisting largely of volcanic rocks which have not been considered as promising from a prospecting point of view. During recent years, however, important occurrences of hydromagnesite have been discovered in this area which will doubtless become of commercial value through the operation of the Pacific Great Eastern

Railway. A considerable business is now being carried on in epsomite, or magnesium sulphate, from the lake about a mile and a half south of Clinton, on the Pacific Great Eastern, and also from the lakes about fifteen miles west of Ashcroft (Basque Chemical Company), near the Canadian Northern Railway.

The following table gives the total output of the three most important products of the district for the year 1918, with the percentages these make of the total production of the Province:—

Product.	Value, 1918 Output.	Percentage of Total for Province.	Remarks.
Coal (tons).....	147,000	5.7	All from Nicola coalfields.
Copper	\$ 132,000	0.8	Practically all from Iron Mask mine, near Kamloops.
Lode gold.....	67,960	2.0	Practically all from Cadwallader Creek area.
Placer gold.....	2,000	0.6	Various sources.

An analysis of the above table is rather disheartening for any one cherishing the hope that District No. 3 possesses mineral potentialities that might ultimately place it in a corresponding position with the other districts from a mineral-production point of view. The realization of this hope, however, judging from developments that have taken place during the past two years, may be considered as being well within the bounds of reasonable probability, although the results in greatly increased actual output may not be expected for some little time. The most important developments, and those on which the above optimistic statement is based, are: (1.) Those in connection with the *Snowstorm* group of claims in the Highland Valley vicinity, Ashcroft Mining Division; (2) the Taseko (Whitewater) limonite occurrences in the Clinton Mining Division; (3) the work in connection with the development of the Aspen Grove copper occurrences in the Nicola Mining Division; and (4) the Ladner Creek gold-bearing argillite-belt in the Yale Mining Division. The work on the *Snowstorm* group of claims is being carried out by the Department of Mines under the provisions of the "Mineral Survey and Development Act."

The four above-mentioned occurrences will be discussed more fully each under the head of its respective Mining Division in the report following. The promising condition of development-work in this district may be largely ascribed to the encouragement given by the Government in having reports made on promising prospects, trail and road building, and in actual development-work undertaken, as on the *Snowstorm* properties.

Clinton Mining Division.

Scottie Creek Chrome-iron Mine.—Practically no work has been done on this property during the present year.

Magnesium Sulphate (Epsom Salts) Lake.—Situated a mile and a half south of Clinton. Extraction of the salt-crust from this lake was carried on to a considerable extent during the winter of 1918-19. Two grades were taken out and stored on the shores of the lake—No. 1 grade, the purer, upper crust, and the No. 2 grade, which underlies No. 1 and is more or less mixed with muddy impurities. No. 1 is sufficiently pure to be classed as technical salts to be used in the arts and manufactures. No. 2 requires refining. During the early part of the present year fifteen cars of No. 2 were shipped from Clinton to the Oroville refinery of the Stewart-Calvert Company, the owners of the deposit.

Watson Bar Creek Placer.—It is estimated by the Gold Commissioner, Clinton, that approximately 270 oz., valued at \$5,000, was secured from this creek during the season of 1919.

Magnesite.—There has been very little doing in the way of developing the magnesite occurrences of the Division during the present year. L. Reinecke, of the Geological Survey of Canada, spent the summer of 1918 in making a mineral survey of the Clinton and adjacent Mining Divisions. A report* on these investigations is published in the August, September, and October, 1919, issues of the monthly bulletin of the Canadian Mining Institute. The following extract on the magnesite occurrences is taken from that portion of the report appearing in the September bulletin, page 942:—

* Undeveloped Mineral Resources of the Clinton District, B.C., by L. Reinecke.

"The composition of certain of these earths is given in the table below. Analyses 4 and 5 illustrate the increase in calcium content with depth. I have been informed by F. Calvert, who tested the Meadow Lake deposit, that the change takes place rather abruptly at a depth of 2 feet in the Meadow Lake deposit. This is true in general of the deposit at Watson lake. The silica content also increases with depth.

Amounts available.—In general it may be said that the purer hydromagnesites are flat deposits outcropping on low ground. The upper $1\frac{1}{2}$ to $2\frac{1}{2}$ feet is, in general, of high grade, but from that depth down the siliceous and lime content is too high for commercial exploitation. The only known exception is one of the outcrops at Watson lake which is believed to be of good quality to a depth of 5 feet. Dr. K. A. Clark, of the Mines Branch, determined the 'apparent specific gravity' of lumps of this material as they were dug from the deposit at Watson lake as 1.22. This makes the weight of a cubic yard of the hydromagnesite as it lies in the deposit, including voids, 2,050 lb. Tonnage was calculated from this factor on the supposition that only the material outcropping was of commercial value, and from such scanty data as to depth as were available. Figured on this basis there is about 7,000 tons of high-grade material at Clinton, 25,000 tons at Watson lake, and 180,000 tons at Meadow lake. Besides the better-grade hydromagnesite, there are large quantities of impure material in all three places."

Clays.—The following extract is from that portion of the above-mentioned report appearing in the August bulletin of the Canadian Mining Institute, page 874:—

"This district is one of the few in Canada in which occurrences of residual clay has been found. There is a great dearth of workable deposits of kaolin and high-grade fireclay in Canada, and as kaolins are to be looked for in such residual deposits, a special effort was made to examine and sample as many outcrops of residual clay as possible. . . . Only one residual clay was of high grade. This occurs in an outcrop of argillites and quartzites of the Cache Creek series west of Fraser river at Chimney Creek bridge. Robert Gardner, of Riske Creek, holds it under a quarry lease. The results of the laboratory tests on clay from this bank may be summarized as follows: The beds tested are numbered from top to bottom.* It will be noticed that 27 feet out of the 55-foot section can be considered fireclay—that is, using above cone 26—and of that 2 to 3 feet is highly refractory. It would be difficult to quarry without including the other less refractory beds. According to Keele, 'these clays as a whole might be worked for the manufacture of low-grade firebrick or mixed with more plastic clay for making sewer-pipe. Crushed and washed they would yield some fine-grained clay for the manufacture of stoneware goods, but the yield of washed clay would probably be too small to repay that operation.' The clays lie fifteen miles by road over a stiff grade from the railway at Williams lake, and the nearest water for washing purposes is 1,500 feet or so below, in Fraser river. They cannot be looked on as a commercial proposition, but the finding of fireclay here should encourage prospecting close to the railway-line farther up the river."

Soda Lake or Red Rock Lake.—The evaporating plant erected and worked to some extent during the year 1918 has not been in operation during the present year.

Taseko (Whitewater) River Iron-ore Deposits.—Wm. M. Brewer, Resident Engineer, Western Mineral Survey District, on instructions from the Honourable the Minister of Mines, made an examination of the above-mentioned deposits between August 14th and September 10th of the present year.†

Lillooet Mining Division.

Cadwallader Creek gold area is the only producer of any importance in this Division.

Pioneer.—This property has been working steadily during the year. Up till the end of October 340 feet of development-work had been run and 4,050 tons of ore put through the mill. The output will probably be considerably in excess of last year, speaking comparatively, the recovery until the end of October being approximately 2,450 oz., valued at \$36,500. Recent newspaper reports state this property has been bonded by the Mining Corporation of Canada, but I have no official confirmation of this. The district generally is deserving of the attention of the larger mining operators who can undertake development on a broader scale than has hitherto been carried out.

* Laboratory results omitted here.

† Note by Provincial Mineralogist.—Mr. Brewer's report sent by him for this Preliminary Review will be found under the heading of his district (No. 6).

Lorne.—Work has been carried on during the year with a small force of men. Development-work consisted of: Woodchuck vein, raising 125 feet; King vein, raising 110 feet; King vein, drifting 130 feet; Turntable vein in King tunnel, drifting 30 feet. Approximate output from development rock only, 125 oz. gold.

Arthur Noel, the owner and manager, has been concentrating his efforts on development rather than on production, with the result that the mine is in a very satisfactory condition. The property is deserving of a more modern and efficient reduction plant than the one now in use.

Ida May.—This property was operated to some extent during the summer, using the small plant described in last year's report. No results are to hand. It is said that telluride ore of high value but not amenable to amalgamation was encountered in the workings. I hope to have more definite data on this for the Annual Report.

Wayside.—The main tunnel has been carried to a length of over 900 feet and a crosscut from near the end has been run for a distance of over 30 feet.

Coronation.—No work has been done on this property during the year.

A considerable amount of assessment-work has been done during the summer on several claim groups in the Cadwallader Creek area, with encouraging results.

The Geological Survey of Canada had a party in the district during the summer completing the geological survey started by the late Dr. Drysdale in 1915.

Copper Mountain, Gun Creek.—Assessment and exploration work has been continued during the year. An excellent trail has been completed, connecting the property with the Bridge River wagon-road.

Tenquille Creek Area.—Assessment-work has been prosecuted during the year, but no results of striking importance have been reported. The trail referred to in last year's report connecting the properties with the Pacific Great Eastern near Mile 71 has been completed, now affording easy access to this area.

Kamloops Mining Division.

There is little change in the mining situation in this Division as compared with last year.

Iron Mask.—This property has been working steadily throughout the year; no particularly important developments have been reported. The output for 1918 was approximately 500,000 lb. of copper, valued at \$125,000. So far as I can gather, the output for 1919 will be practically the same.

Lydia Group.—Work has been suspended on this group of claims, the option under which operations had been progressing during the years 1918-19 having been allowed to lapse.

Queen Bess Mines Co., Inc.—Work on this property during the past year has been confined largely to development, consisting of the following: Main crosscut tunnel, 135 feet; drifting, 400 feet; raising, 40 feet; winze, 54 feet. Development-work is stated by the management to be satisfactory. Twenty-seven tons of silver-lead concentrates was shipped during the year, returns from which have not yet been reported. There is approximately 75 tons of zinc concentrates at the mine waiting a favourable market.

Copper King and Camp McLeod Groups.—The option held by the Granby Company on these properties has been dropped. The trail, however, leading to this promising field (*see* report by W. M. Brewer in Report of Minister of Mines, 1913, page 203) from the head of Seymour arm has been completed during the present year.

War Colt Group.—Reports have been received of a very promising field for prospecting in the area between the headwaters of the Clearwater river and Thunder creek in the extreme northerly portion of this Division. Several claims have been staked by Adolph Anderson, of Swift Creek, B.C., and Lewis Knutson, of Tete Jaune Cache. These are being financed by Edmonton financiers, who have constructed a trail from the Canadian Northern Railway to the claims, a distance of over forty miles. The samples of ore submitted consist of a complex of galena and chalcopyrite. It is proposed to start systematic development in the coming spring.

Ashcroft Mining Division.

The only work carried out in this Division worthy of mention during the present year is that in connection with the Epsom Salt lakes near Basque, on the Canadian Northern Railway, and

the development operations on the *Snowstorm* group of claims in the vicinity of Highland valley; the latter being carried out by the Government under the provisions of the "Mineral Survey and Development Act."

Epsom Salts Lakes near Basque.—These are being operated by the Basque Chemical Production Company, Limited; head office, 509 Richards street, Vancouver; manager, J. G. Miller; superintendent at works, W. E. Pinchin. Considerable work has been done on this property since last year's report. Storehouses for the raw crust, drying-house, mill and classifying building, storehouse for finished product, besides camp to accommodate twenty men and stables, have been erected. Steady shipments are probable from now forward. Two grades of salts are marketed. No. 1 is sufficiently pure to be sold for medicinal purposes (U.S.P.); this is obtained simply by drying, crushing, and screening the purer upper crust of the lake. No. 2 is technical grade for the arts and manufactures, and is now being used in large quantities for tanning purposes.

Mr. Miller, the manager, writes under date of November 24th as follows: "During 1918 we made no tonnage shipments; we did send out a number of small samples during 1919. We actually started shipping our first car of 30 tons on August 16th, 1919; the second car was shipped in September, and we hope to ship five or six car-loads of 30 tons each before the end of the year.

"At the present time we are adding to our equipment to increase the output; this is necessary because of the fact that we have about fifteen car-loads ordered at the present time. Most of the orders we have in hand are for tanners' use in Ontario; we also have two or three car-loads ordered for medicinal salts. We hope to ship one of the latter cars in November or early in December.

"Our future policy will be to secure the Canadian trade for the sulphate of magnesia or Epsom salts. We are informed that there is imported into Canada annually about \$2,500,000 worth of this product; it is our ambition to even this balance of trade and increase our capacity for the output of the salts as fast as the demand warrants.

"We have made arrangements with the Ontario Oil and Turpentine Company, Limited, of Toronto, to act as the distributors for Canada of the Basque Chemical Production Company.

"We have made fairly good inroad to marketing the salts, which are an exceptionally high grade of purity, and we are justified in making the boast that there is no other deposit of its kind."

Snowstorm Group.—(See Report of Minister of Mines, 1917.) This property is situated on Kirkpatrick mountain, on the north-east side of Highland valley, about thirty miles from Ashcroft along the Highland Valley road.

Diamond-drilling operations were started on the *Snowstorm* claim about the middle of January, 1919, by the Department of Mines under the provisions of the "Mineral Survey and Development Act." Work was carried on through the summer under contract by the International Diamond Drill Contracting Company, of Spokane, Wash., using a machine cutting a $\frac{7}{8}$ -inch core. Eight holes were put down at dips varying between 30 and 60 degrees and running in lengths between 400 and 1,125 feet, aggregating a total of 5,736 feet. The country-rock is of a granitic nature, with occasional indications of copper mineralization on the surface, but no particularly large, well-defined ore-bodies showing.

It was for the purpose of determining conditions below the surface that diamond-drilling was resorted to. Surface and assay plans of the work have not yet been completed, so that a detailed report cannot at present be compiled; this will be presented in the Annual Report. Out of the eight holes put down, six passed through mineralized zones which indicated bodies of commercial ore not represented on the surface. In all the holes three typical rock formations were passed through. In the absence of a technical classification of these the following descriptions will have to suffice:—

- (1.) Granitic country-rock.
- (2.) Dark-coloured, fairly fine-grained porphyritic rock with white porphyrites. Cores show well-defined contact with granitic country-rock not represented on surface to any extent.
- (3.) Mineral-bearing rock, grey to dark coloured, some places sericitic, mineralized with chalcopyrite, bornite (erubescite), and in places specular iron. Where mineralized, usually carries considerable pale-green epidote. Looks like an altered basalt or diabase. This formation is shown by drill-holes to be much more extensive than is indicated on the surface.

From the results obtained to date on the *Snowstorm* claim, one is justified in the statement that there are very extensive ore-bodies going to considerable depths and of commercial value existing in this particular locality, the existence of which is not indicated on the surface.

Iona Sub-group.—Situated about three-quarters of a mile south-westerly from the *Snowstorm* claim is a sub-group of claims surrounding the *Iona* claim proper. In the 1917 Report of the Minister of Mines the statement is made that on the *Iona* claim there is an occurrence of mineralized ground showing on the surface over an area at least 60 feet in diameter and from which a sample gave 1.3 per cent. copper.

Work was started on this claim late in the summer with the idea of finding approximately the surface limits of this ore-body, so as to be able to place more intelligently the location of diamond-drill holes for exploration at depth. The results of this work so far have proved very satisfactory.

An open-cut running north-westerly from near the south-easterly contact was put in. This is 40 feet in length, running *across* the apparent strike of the ore-body; the assays received from samples forwarded by the superintendent show an average of 3 per cent. copper across the 40 feet; continuing north-westerly, open-cuts were put in which showed the ore-body at this section to be approximately 200 feet in width, the samples from these smaller open-cuts also giving an average of 3 per cent. copper. At 300 feet south-westerly along the strike an open-cut gave 1.50 per cent. copper, and at 2,700 feet south-westerly from the first section and 600 feet vertically below it an open-cut gave 2.80 per cent. copper. Snow coming on prevented further efficient surface work, and a tunnel was started to crosscut the ore-body near the first section mentioned, which will give a maximum vertical depth of 75 feet. Latest information from the mine (December 16th) gives the length of the tunnel as 85 feet, the last 30 feet being in ore, with the face of the tunnel 40 feet vertically below the surface. The drilling and surface work carried on has been under the superintendence of Allan K. Stuart.

A survey of the claims has recently been made by W. S. Drewry, of Victoria. This comprises a block of twenty-two claims and fractions.

O.K. Mine, Highland Valley.—Work on this property has very recently been resumed. The intention is to sink a shaft and do some further development-work before starting the 50-ton capacity concentrator which was in operation during 1917.

Nicola Mining Division.

Coal.—The Middlesboro Collieries, Limited, and the Fleming Coal Company have been operating steadily throughout the year. The gross output of this field for 1918 was 146,776 tons; a decreased total output is foreshadowed for 1919.

STUMP LAKE AREA.

There has been a somewhat increased interest in this area during the present year.

Donohoe Mines, Stump Lake.—Operations were resumed on this property during the summer. The workings in connection with the Joshua shaft have been unwatered to below the 400-foot level, exposing quite considerable bodies of ore ready for stoping. A small shipment of ore has already been sent out. It is the intention of the management to continue shipping the better-grade ore and at the same time install a new concentrating plant. With silver at the price it is at present, operations should be easily made a success.

Mary Reynolds Mine, Stump Lake.—R. R. Hedley has been conducting operations on this property and has done considerable work in connection with the mine, besides building a road from the mine to connect with the main Kamloops-Nicola highway.

During the year the following work has been done, as well as a considerable amount of prospecting: Deep open-cutting, 60 feet; tunnelling, 140 feet; drifting, 74 feet; raising, 30 feet. Ninety-seven tons of ore has been shipped, the smelter analysis of which is as follows: Silver, 51.2 oz. a ton; gold, 0.143 oz. a ton; lead, 1.40 per cent.; zinc, 2.40 per cent.; sulphur, 2.60 per cent.; silica, 52.50 per cent.; iron, 6.60 per cent.; lime, 6.40 per cent. Thirty-three tons of ore is in transit.

ASPEN GROVE.

Considerable interest attaches to this field by reason of the fact that operations are now under way which will determine whether or not all or any of the numerous low-grade copper-showings of this vicinity have sufficient body to justify the statement that a real mine exists in

this field. During the autumn of 1918 options were taken on a large number of claims (approximately seventy-five) by strong financial interests represented in Joseph Errington. During the past summer Mr. Errington has had very thorough geological and petrographical investigations carried out in connection with the geology and rock genesis of the district. As a result of these investigations it was decided to thoroughly explore the field by diamond-drilling, and no time was lost in starting operations. Two drills have recently arrived for this work; a camp has been erected, including an assay office, the latter being in charge of a competent assayer who will be resident at the camp.

Vernon Mining Division.

Black Hawk.—Situated near the head of Irish creek, about sixteen miles northerly from Vernon; owner, A. J. McMullen, Vernon. Considerable work has been done on this property. One tunnel, 240 feet in length, with branch tunnel 40 feet in length, is being driven in country-rock; also another tunnel 100 feet in length, with branch tunnel 50 feet. Both of these were driven with the idea of tapping a vein which traverses the property, but from which no results ensued. There is a quartz vein traversing the property which shows on the surface in occasional outcroppings over a considerable distance. The country-rock is of a basaltic nature. Surface samples taken in the vicinity of the workings along a distance of approximately 150 feet gave the following results:—

(1.) Near south-east end of workings, across 3 feet 6 inches: Gold, 0.56 oz. a ton; silver, 0.20 oz. a ton.

(2.) About 75 feet north-west from No. 1, across 6 feet: Gold, 0.56 oz. a ton; silver, 0.20 oz. a ton.

(3.) Across 5 feet in shallow incline north-west from No. 2: Gold, 0.20 oz. a ton; silver, 1.50 oz. a ton.

This property is situated less than half a mile from the location-line of the Okanagan branch of the Canadian Northern Railway and should be deserving of further investigation.

Yale Mining Division.

Emigrant Mines, Ltd.—There has been nothing doing on this property during the past year.

Emancipation Mining Co., Ltd.—Work has been continued on this property throughout the year. A new tunnel has been driven on the vein at a level approximately 75 feet below the main tunnel and for a distance of about 80 feet. A winze has been sunk from the main tunnel to a depth of 50 feet. About 8 tons of ore has been shipped, the value of which is estimated at \$350 a ton in gold.

River Gold Recovery Co.—Operating last year on a lease situated about half a mile below Hope. Operations closed last autumn. The plant has been removed.

Ladner Creek.—A trip was made up Ladner Creek valley in the month of June for the purpose of investigating as to whether conditions warranted the construction of a trail to facilitate prospecting operations in this vicinity. The examination was necessarily of a very casual nature.

Ladner creek runs south-easterly to the Coquihalla river, which it joins about sixteen miles above Hope. This creek traverses a series of argillites which are generally ascribed as belonging to the Cache Creek formation. This argillite-belt appears to be of considerable width and extends north-westerly to Sivash creek, on which the *Emigrant* mine is situated. The *Emancipation* mine, on the north slope of the Coquihalla valley, is also situated in this same belt. Numerous occurrences of quartz, either of lenticular or vein conformation, are present throughout this whole argillitic formation, and a number carry gold values of commercial importance. Only two samples were taken, and these were from the *Idaho* claim, owned by Palmer & Bailey. Pannings were made from O'Connel's and other claims which showed good gold values. The assay results from the *Idaho* samples were as follows:—

(1.) Across 4 feet on hanging-wall side of vein (vein 23 feet in width): Gold, 0.44 oz. a ton; silver, 0.06 oz. a ton.

(2.) Across 5 feet near centre of ore-body, which is exposed for width of 20 feet with walls not yet uncovered, and 150 feet north-west from No. 1 on same vein: Gold, 0.16 oz. a ton; silver, 0.04 oz. a ton.

This area is deserving of further investigation.

SOUTHERN MINERAL SURVEY DISTRICT, No. 4.

PRELIMINARY REPORT BY PHILIP B. FREELAND, RESIDENT ENGINEER.

(Headquarters, Grand Forks.)

The above district includes four Mining Divisions—Grand Forks, Greenwood, Osoyoos, and Similkameen. The mineral production of this district is considerably below the average, chiefly owing to the closing-down of the Granby's mines at Phoenix in June, 1919, on account of a shortage in coke for the smelter, and to a decrease in the bodies of possible payable ore adding to the high cost of production. In 1918 Granby produced 443,134 tons of ore, as against 142,546 tons in 1919, a difference of 300,588 tons.

The cessation of mining at Phoenix has reduced the output of copper to practically *nil*, and also materially cut down the production of gold and silver.

There have been no new discoveries of any particular importance in the district other than a few high-grade fissures of silver ore on Wallace mountain, Beaverdell, and a strontianite deposit near Princeton.

The scarcity of prospectors and capital, also the fact that large areas are Crown-granted, on which development has not been carried on for many years, is a probable cause. A great many of the Crown-granted areas are well mineralized, and, though the ores are somewhat complex, the present facilities for power, transportation, and new methods of concentration and separation might make them attractive to capital, providing a large enough area for operation could be acquired at a reasonable figure.

One of the largest developed copper-mines, the *Copper Mountain* group at Princeton, having approximately 12,000,000 tons of low-grade ore, has not as yet begun operations. When this property begins to produce the copper-output of the district will once more assume normal proportions.

Grand Forks Mining Division.

Union.—This mine shipped 81 tons of silver-gold ore to the Trail smelter, having an assay of approximately 0.28 oz. in gold and 31 oz. in silver to the ton. Analysis gives: Gold, 0.28 oz.; silver, 31 oz.; copper, 0.05 per cent.; zinc, 0.015 per cent.; sulphur, 1.6 per cent.; silica, 74.8 per cent.; iron, 4.40 per cent.; lime, 5.90 per cent. Development consisted of a crosscut from No. 2 tunnel 50 feet long, which developed 22 feet of ore averaging about \$20 in gold and silver. Work will be continued during the winter.

Maple Leaf.—Approximately 200 feet of development-work was done on this property during the year. The lower tunnel was continued west and a crosscut driven north. The ground developed showed a good deal of mineralization of iron pyrites, with some values.

Rock Candy.—This mine, owned by the Consolidated Mining and Smelting Company, of Trail, has been developed by tunnels, crosscuts, and a raise. The deposit formed near the surface under low temperature conditions is approximately 140 feet wide at the lowest point developed. The entire 140 feet is not commercial fluorite, the greater portion being a vein material of chert, barite, and quartz, with small inclusions of limonite, chalcopyrite, galena, chalcocite, pyrite, and covellite. The surrounding rocks appear to belong to the Alkali-Syenite group. The company has built an aerial tramway two miles long to connect the mine and mill; the latter having a capacity of 100 tons a day.

Molly Gibson.—A crosscut tunnel driven 265 feet encountered ore 60 feet below the old inclined shaft. A drift has been driven from the bottom of the shaft 10 feet and shows some ore assaying about \$80 a ton in gold and silver. This property is expected to ship this winter.

Berlin.—This mine shipped 6.5 tons of gold and silver ore to Trail, containing 26.345 oz. gold, 82.75 oz. silver, and 117 lb. copper. The mine has been closed down most of the year.

Lightning Peak Group.—This property was developed by 50 feet of tunnels, 25 feet of shaft, and 50 feet of open-cuts. Ten tons of high-grade silver ore was shipped.

Rampulo.—This claim was worked by T. Cortiana and developed to the extent of 75 feet of open-cut and tunnel. A foot of ore was exposed at the face carrying silver and lead.

Fife Lime-quarries.—This property shipped 17,000 tons of limestone to Trail for fluxing purposes.

Little Bertha and Pathfinder Mining Co.—This company has let a contract to A. Savage, of Grand Forks, for 700 feet of tunnel. Work commenced in December.

Yankee Boy.—This old property has been leased by J. R. Nichol *et al.*, and a considerable amount of development-work done, but no ore shipped.

Emma.—This mine was closed down for part of the year. Approximately 19,000 tons of low-grade copper ore was shipped to Trail.

Osoyoos Mining Division.

Hedley Gold Mining Co.—This company continued operations throughout the year on the *Nickel Plate* group, milling about 60,000 tons of gold ore, containing approximately \$480,000 in gold and \$17,000 in arsenic.

Horn-silver Mine.—This property shipped about 841 tons of ore to Trail and Tacoma smelters, containing 102 oz. in gold and 39,526 oz. in silver.

Golconda.—This property, situated near Olalla, Keremeos, developed the lower tunnel and shipped 20 tons of copper-silver ore to Trail.

Similkameen Mining Division.

Canada Copper Corporation.—Work on this company's property at Copper mountain and Allenby near Princeton, has been chiefly confined to the construction of surface plants, installation of machinery and equipment, preparatory to a commencement of operations. The work at Allenby comprises the following: Concentration-plant building has been completed and all machinery is installed with the exception of the power-transmission shafting and belting; a permanent pumping plant on the Similkameen river completed and ready for electric power, also additional water-lines for industrial, domestic, and fire-protection systems; heating plant with battery of four 100-horse-power boilers and assay office and laboratory building erected.

On February 6th a skeleton track was completed to Allenby, on the Kettle Valley branch line from Princeton, which permitted the delivery of about forty car-loads of machinery and material. Following this, and before the road was ballasted, a strike was called by the railroad-construction employees on April 1st, and further deliveries did not take place until the end of August, at which time some thirty car-loads of machinery and equipment were waiting delivery in the Princeton yards. Traffic has been maintained to Allenby since that time, but completion of the railroad to Copper mountain will be delayed until the early summer of 1920.

Copper Mountain Mine.—Work at the mine has been carried forward throughout the year to December 1st, when the camp was closed down for the winter. The following is a résumé of the work done: Timbering the main shaft and stations, enlarging haulage levels, and timbering where necessary; main ore-passage from surface, 4,073-foot to 3,107-foot level, completed; installing dumping-stations and loading-chutes. On the surface the following was accomplished: Temporary power plant; head-frame for shaft; temporary compressor plant dismantled and replaced with permanent plant; air-lines; hoist-house and hoist; concrete powder-magazine; addition to dining-hall; steel-sharpening shop; laundry building; extending telephone system; primary bins and crushing plant, with trestle and trackage connecting with portal of 3,170-foot level complete, with foundations ready to receive crushers; conveyor-house from crushing plant to shipping-bins ready for installment of conveyor; main storage-bins of "straddle" type completed; surface tramway from railroad-station site to 3,170-foot level for transportation of incoming supplies.

Railroad.—The following are the percentages of various classes of work: Grading, 85 per cent.; tunnels, 50 per cent.; bridges, 40 per cent.; track-laying, 40 per cent.; ballasting, 10 per cent.

Wagon-roads.—A large quantity of material had to be hauled over the roads by motor-trucks and teams to Allenby and Copper mountain, as a result of which the main Government road was subjected to heavy and continuous traffic, and the company wishes to record its appreciation of the speedy measures taken in making repairs by the Minister of Public Works and the District Road Engineer. The company spent during the year some \$5,350 over and above the amount advanced by the Government.

Tulameen River.—Placer-work has been carried on in a desultory manner by a few prospectors on the benches adjacent to the Tulameen river, with the result that a few ounces of gold and platinum were recovered.

Olivine Mountain.—Assessment-work on the Slate Creek side of Olivine mountain developed segregations of copper carbonates near the contact of the augite syenite and peridotite. Samples from open-cuts and test-pits gave as high as 4 per cent. copper.

Princeton Coal and Land Co.—This company produced approximately 20,557 long tons of coal during the year.

Coalmont Collieries, Ltd.—This company shipped 9,958 tons of coal to the end of November, when work ceased.

Greenwood Mining Division.

Granby Mines, Phoenix.—These mines were operated until June 18th, 1919, when the shortage of coke caused a close-down of the smelter. Since that time operations have not been resumed and the smelter was partially dismantled. There are several thousand tons of low-grade ore still in the mine, and the concentration of the ore is, it is believed, under consideration.

Providence.—This mine is leased to Al. Morrison *et al.*, of Greenwood, and twenty men employed. Development-work amounted to 200 feet of drifting on the 300-foot level, 216 feet of drifting on the 400-foot level, and 80 feet of raising between the 300- and 400-foot levels. A 6-drill compressor and 25-horse-power electric hoist are used. Some 330 tons of ore was shipped to Trail, having an average assay value of \$13 in gold and \$110 in silver. Treatment cost varied between \$5 and \$6. Transportation, \$5.50 a ton.

B.C.—This mine was leased to J. St. Claire, of Elholt, and shipped 120 tons of copper-gold ore to Trail.

Don Pedro.—This mine was leased by Chas. Johnson, of Greenwood, and 18 tons of ore was shipped to the Trail smelter.

Stemwinder.—This old mine, on which no work has been done for many years, was leased by J. Cunningham, of Phoenix. Some copper-gold ore was sorted and shipped from the dump, amounting to 29 tons.

WALLACE MOUNTAIN, BEAVERDELL.

Bell.—This mine, which is owned by Duncan McIntosh and P. Crane, of Greenwood, worked continuously throughout the year, and several open-cuts developed new zones of high-grade silver ore. Shipped 254 tons of ore to Trail.

Sally.—The lessees, Nordman & Sons and a Penticton syndicate, have done a considerable amount of development-work on the *Sally* and *Rob Roy* mines. A new lead of high-grade silver ore was uncovered on the *Rob Roy*. Shipped 106 tons of ore to the Trail smelter.

Buster.—This mine, owned by Joe Kelly, shipped 8 tons of ore to Trail.

Castor Fraction.—This claim was leased by J. Perry *et al.*, and 35 tons of silver-lead ore was shipped.

Duncan.—This claim was leased by J. McKellar, of Greenwood, and 31 tons of silver-lead ore was shipped to the smelter.

Nepanee.—This mine was worked by J. M. Barret, who shipped 1 ton of ore to Trail.

North Star.—This mine, owned by R. Wood, of Greenwood, shipped 2 tons of ore.

Revenge.—This mine was leased by Pat Crane *et al.* from J. N. Barret. Some development-work was done and 34 tons of ore was shipped to Trail.

Standard Fraction.—This claim, leased by the Nordman Bros., of Coltern, shipped 27 tons of ore. The ores are galena, pyrite, sphalerite, tetrahedrite, and pyrargyrite in a gangue of sericite quartz and altered rock. These occur in shear-zones in an acid-quartz diorite.

Waterloo.—This mine, situated in Lightning Peak camp, is owned by G. Rendall *et al.*, of Greenwood. Owing to the shortness of the season, work was carried on with difficulty. Development below the upper tunnel showed a continuance of the lead. Shipped 13 tons of high-grade silver ore to the Trail smelter.

EASTERN MINERAL SURVEY DISTRICT, No. 5.

PRELIMINARY REPORT BY A. G. LANGLEY, RESIDENT ENGINEER.

(Headquarters, Revelstoke.)

SUMMARY OF MINERAL PRODUCTION, No. 5 DISTRICT.

According to figures so far obtainable regarding the silver, lead, and zinc shipments, the production of each of these metals, with the exception of zinc, is expected to show a slight decrease as compared with that of 1918.

Zinc.—Zinc production has been maintained principally by the *Sullivan* mine, the output of which would have been considerably greater had it not been for the strike called by the O.B.U., which resulted in the property closing down on September 12th and the "walk-out" of over 200 men.

The balance of the zinc produced in the district was chiefly derived from the mines of the Slocan and Ainsworth Divisions. This zinc is in the form of concentrates from the silver-lead-zinc ores, and invariably carries high silver values. As the Trail smelter has not been accepting zinc ores until quite recently, the bulk of this material has been shipped to the United States, which was only possible on account of the high silver content.

Since the temporary closing of the *Sullivan* mine the Consolidated Mining and Smelting Company has been accepting high-grade zinc ores from the Slocan.

Silver.—The Slocan Mining Division is by far the largest silver-producer not only in the district, but in the Province, so the production of silver can be fairly well gauged by the activities in the camps in this area. So far, it would appear that the production will show a decrease as compared to that of 1918, for the following reasons: The curtailment of shipments by the *Standard* mine at Silverton, which in past years has been by far the largest shipper; decreased activity at the *Galena Farm*, *Van-Roi*, and *Hewitt* properties; the same applying to the *Surprise* mine at Sandon, which was the leading shipper last year.

Active development-work is being carried on at most of the above-mentioned properties, and it is anticipated that the lull in production will only be of a temporary nature.

Lead.—The lead production will probably show a decrease, for the same reason as that given for the silver production.

Gold and Copper.—The principal source of the gold and copper production is the Rossland camp. Owing to economic conditions the tonnage shipped shows a slight decrease, but, according to returns so far received, the value of the production of these metals will compare favourably with that of the previous year.

Coal.—The coal production of the East Kootenay District will show a considerable decrease as compared with that of 1918. The causes of the decrease are due to lack of demand during the earlier part of the year, followed by a close-down from May 24th until late in August. The strike which brought about the stoppage of all work arose from a dispute regarding the wages of the outside workmen in accordance with the shorter hours of labour provided by the Legislature, and finally developed into a struggle between the United Mine Workers and the O.B.U.

Concluding Remarks.—Generally speaking, the metalliferous mining throughout the district has been somewhat handicapped by lack of efficient labour during the first nine months of the year, but since the advent of winter these conditions are said to be improving. Owing to the unusual dryness of the season, several properties suffered from lack of sufficient water to run their power plants and concentrators.

The only properties which have been troubled with strikes are the *Sullivan* and *North Star* mines in the East Kootenay. The *North Star*, which only employs a few men compared to the *Sullivan*, was not forced to close down for any length of time, but the *Sullivan* is still having trouble from the strike which practically closed down the property on September 12th.

The slight decrease in the prices of lead, zinc, and copper did not have any serious adverse influence on the mining activities, while the recent unprecedented rise in the price of silver will not only enhance the value of the silver-lead deposits now being worked, but should do much to renew interest in many of the old prospects and mines of the district which are now lying dormant.

The completion of Clarence Cunningham's 150-ton concentrator at Alamo, the erection of a 100-ton mill at the *Noble Five* mine, and the proposed 1,500-ton concentrator for the Rossland

ores mark a very active year in mill-construction and a new era in the metallurgical history of the district. All of the above mills are designed primarily for the treatment of ores by flotation; the older mills were originally designed for water-concentration and have since had flotation units added.

Future Outlook.—The possibilities for an increase in the production of silver, lead, and zinc during the coming year are most encouraging. The underground development-work being carried on at some of the leading properties has been highly satisfactory, while the results of this year's prospecting in the district should register the names of more properties on the shipping-list. The addition of the two modern concentrators at Alamo and Cody respectively should help to materially increase the production of the Slocan, by allowing ore, either too low grade or too complex to ship crude, to be mined economically.

The *Sullivan* mine, which is capable of producing a much greater tonnage than it has done so far, will probably show a substantial increase, providing economic conditions are favourable; hence a larger production of lead and zinc may be reasonably looked for from this source.

With the completion of the large concentrator now planned by the Consolidated Mining and Smelting Company for the treatment of the low-grade gold-copper ores of the Rossland camp, an increase in gold and copper is almost assured.

Golden Mining Division.

The mining activities in this Division show little, if any, improvement over those of last year.

The *Coverapee*, at Field, which was the leading shipper, was temporarily tied up by litigation, arising from a dispute regarding the boundary-lines of this property and those of the *Monarch* between the respective owners. According to latest reports, the *Coverapee* and *Monarch* have amalgamated, and are now being managed by Mr. Adkins, who formerly operated the *Coverapee*.

C. J. Lincke, who is interested in the *Tarheel* group of claims on the Middle fork of the Spillimacheen, is reported to be making arrangements to pack out some copper ore.

The *Rose* and *Daisy* claims, formerly known as the *I.X.L.* and *Condor*, have been bonded to Mr. Rowley, who has a small crew of men at work.

Windermere Mining Division.

Paradise.—This property has been operating steadily during the year and has maintained its average production, although somewhat handicapped by labour conditions. New development-work being carried on in the lower workings promises well for the future of the mine.

Trojan.—Active development-work has been carried on during the season by the Trojan Mining Corporation. A 9 x 8 Ingersoll-Rand compressor and a 35-horse-power gasoline-engine were installed. The principal values are in copper. The ore occurs in a quartz-filled fissure. Shipments for the year amounted to 43 tons.

Sitting Bull.—No mining was done at this property during the year. Thirteen tons of ore extracted during previous years was shipped to Trail.

Burman Group.—Situated on Slade creek, almost opposite the *Sitting Bull*. John Burman, the owner, has been occupied during the season in driving a crosscut to tap the vein, in which a high-grade shoot of ore was encountered in a drift near the surface. At the time of examination the crosscut was driven for 100 feet through a highly silicified limestone, but was not in quite far enough to reach the vein.

Lead Queen.—This property is situated on Frances creek. It was recently acquired by Paul Denhart, of Seattle. During the year 40 tons of silver-lead ore was shipped to Trail. Recent work has consisted of driving a crosscut to intersect the vein at a point below the ore-shoot.

Relief Group.—This property is near the summit of Slade mountain and at a short distance from the *Sitting Bull*. The trail was opened to the property this year, and some work done on the claims by J. C. Pitts and partner, of Invermere. The ore is high-grade silver-lead. A small shipment was made in 1917 from this property, but as the ore had to be packed out for a distance of nine miles to a wagon-road, and then hauled eight miles to the railway, the net profit after deducting transportation charges was not very encouraging, and the property was idle during 1919.

Isaac.—This property is situated on Frances creek at a distance of a few miles from the *Lead Queen*. For many years it has been owned and operated by H. E. Forster, of Wilmer; this year it was bought by Paul Denhart, who, it is reported, intends to operate the property during the winter.

Nip & Tuck.—W. D. McMillan, of Athalmer, has taken an option on this property, and had a small crew of men working this year.

The claims are situated near the headwaters of McDonald creek. It is also reported that E. Watson and others have taken a lease on the *Ptarmigan* and *Red Line* groups, that the results so far have been encouraging, and that teams are now engaged in the hauling of ore.

More than usual outside interest has been taken in properties in the neighbourhood of the North fork of Toby creek and up the main creek.

The activity among the prospects of this Mining Division has been more pronounced than last year, and with the prevailing high price of silver, still further activity may be expected during the coming season.

Fort Steele Mining Division.

Sullivan.—The development of large ore-bodies on the low tunnel-level and the discovery of high-grade zinc ore in previously unexplored ground in the upper level add to the already immense ore reserves of this mine. The output for the year will exceed that of last year, in spite of the fact that shipments have been greatly curtailed since the partial closing-down of the property on September 12th, due to a strike called by the O.B.U.

North Star.—Under the management of O. C. Thompson, this property has been a steady producer during the year, and recently attained the rank of the second largest shipper in the East Kootenay. The bulk of the shipments has been made from the old dumps.

St. Eugene.—This famous property is still producing in a small way under the direction of the Consolidated Mining and Smelting Company. Shipments this year will exceed those of the previous year.

Guindon Group.—This property is situated almost directly opposite to the *St. Eugene*, on the other side of Moyie lake. It is being developed by Frank Guindon, an old-time miner of Moyie. A small shipment of silver-lead ore was made during the year.

Victor.—It is reported that G. Gundry has taken a lease and bond on this property, and intends erecting a 50-ton concentrator during the winter. The property was originally opened up by R. Abernethy, of Spokane, some ten or fifteen years ago. It is situated on Maus creek at a distance of about nine miles southerly from Fort Steele. The ore is rather a complex mixture of galena and zinc-blende, carrying good average values in silver and lead.

At Skookumchuck, on the Kootenay river, prospecting-work has been carried on during the season on a showing of copper ore. It is understood that the extent of the work done so far has not been sufficient to define the ore-body, but the results so far obtained are said to have been encouraging.

Kootenay King.—This property belongs to William Myers, of Fort Steele, and has been developed and prospected by him for a number of years. It is located on a tributary to Wild-horse creek at a distance of about ten miles from Fort Steele. The ore is said to run about 10 oz. in silver and 15 per cent. lead. Mr. Myers put in a season's work on the property.

The usual amount of prospecting-work has been done in St. Mary country, and it is reported that Evans Bros., of Cranbrook, who are among the pioneer prospectors of the district, have been successful in bonding the *Achilles* group of copper claims for a substantial amount.

The hematite-deposits of Sand creek and Bull river have attracted more than usual attention this year. The former property, which was examined by the writer, is situated within about eight miles north of the railway at Galloway. The ore, which is a red hematite, occurs in a bedded fissure. Very little work, principally consisting of several open-cuts, has been done; although the vein is small, the good quality of the ore and the easy accessibility of the property are strong factors in its favour, while the possibilities from a geological standpoint appear to warrant further work being done to prove the existence of a sufficient body of ore to be of economical importance. A sample across 3.5 feet ran: Iron, 52 per cent.; silica, 22.6 per cent.; phosphorus, *nil*; sulphur, *nil*. A sample across 1 foot ran: Iron, 57.4 per cent.; silica, 15.6 per cent.; phosphorus, *nil*; sulphur, *nil*.

The operations of the Gamble Mining Company and the Wild Horse Dredging Company on the placer deposits of Wildhorse creek created great local interest and speculation. The former company piped water across the creek and operated a monitor on some virgin ground on the west side. Owing to the unusual dryness of the season, the shortage of water caused the cessation of operations during the latter part of the summer. However, results were sufficiently encouraging and work will be resumed next season.

The Wild Horse Dredging Company, which started operations early in the year, proceeded to build a boom dam across the creek, with the object of sluicing the gravel off the bottom of the main channel and recovering the gold from the bed-rock. Although they rushed the construction of this dam, high water came earlier than was expected and washed out one end which was not quite completed. It is reported that another attempt will be made next season. This company also installed a drag-line scraper above the dam, with which they intend to remove the gravel from the main channel at this point.

On Perry creek A. J. Palmquist has been busy during the season completing a flume to conduct water to a point near the falls, where he intends to operate monitors on a high gravel-bank on the southerly side of the creek.

Ainsworth Mining Division.

NEAR AINSWORTH.

Florence.—This property, which has been operated steadily during the year, was the largest shipper in this Division. The output will compare very favourably with that of last year, which reflects credit on the management, for production was somewhat handicapped by having to contend with heavy wet ground in the spring, which required continual attention and much timbering. Efficient labour was scarce, and owing to the dryness of the season there was a shortage of sufficient water for power and milling purposes for a brief period. During five months it is reported that the average daily tonnage supplied to the mill was about 100 tons.

Bluebell.—The production of this mine during the last two years has been to a large extent dependent upon the large deposit of lead carbonates in the surface oxidized zone above the adit level, that from the lower levels of the mine being stopped by the influx of water, which necessitated the installation of more powerful pumping machinery. It is reported that the mine will soon be unwatered and that mining on the levels below the lake-level will be resumed. The production will fall short of that of the previous year.

Highland.—This mine, which is owned and operated by the Consolidated Mining and Smelting Company, will show a decrease in production. The concentrator recently started again after being idle for some months. New ore developments are reported. Adjacent claims were acquired, making a total number of seven claims in the group.

Ruth.—W. A. Smith and associates work the old tailings-dump under lease. A short section of road was built and the material hauled to the upper terminal bins of the No. 1 mine. Assay values of various samples taken gave an average of about 10 oz. silver and 1 per cent. zinc. On account of the high percentage of lime a low smelting rate was obtainable.

Tariff.—F. Kennedy and C. Bridge, of Ainsworth, who have been working this mine under a lease, were successful in striking ore on the foot-wall of the vein at the 80-foot level. The road to the property was improved. Total shipments to Trail were 48 tons.

No. 1.—This property, which is owned and operated by the Consolidated Mining and Smelting Company, only shows a production of 235 tons, against about 6,000 tons last year.

Spokane-Trinket.—This property has been operated successfully by J. McDougall and shows an increase in production over that of last year. The ore-bodies are small but persistent in occurrence. It is a good example of a small property which can be worked profitably by careful and intelligent management. If encumbered with unnecessary overhead expenses it would probably be doomed to failure, the fate of many prospects and mines.

Quite a little interest has been aroused over promising-looking showings discovered this summer on several claims near the *Bluebell*, and upon which a little work had been done many years ago.

A. J. Curle, of Kaslo, while looking over some ranch land, found a piece of galena float; tracing it up he found the vein in-place. Prospecting-work done on the lead this summer is said to have been encouraging, and according to recent reports more extensive exploratory work will be carried on by a syndicate composed of A. J. Curle, R. Guthrie, and W. T. Kirby, of Winnipeg.

The other claim, on which a little work uncovered some fairly high-grade silver-lead ore, was staked by B. L. Eastman and R. D. Hearn, of Riodel.

SOUTH FORK OF KASLO CREEK.

Cork-Province.—This mine, which ranks as the largest shipper from the South fork, has only been intermittently worked during the year by a small crew of men. An exhaustive examination of the property was made by R. H. Stewart in August. In his opinion about \$100,000 is needed to carry out a successful programme of development. It is reported that the necessary steps have been taken for the refinancing by increasing the par values of the shares. Shipments for the year total 250 tons of silver-lead concentrates.

Gibson.—This is among the earliest locations on the creek. It was acquired three or four years ago by D. K. May, of Spokane, who by an active stock-selling campaign succeeded in interesting a considerable amount of Spokane and Portland capital. During 1918 a hydro-electric plant was installed under the supervision of W. W. Elmer, the mining engineer in charge of the property. Power will be generated by a Pelton wheel and a 120-kw., 2,200-volt, 60-cycle, 3-phase generator, which equipment is lying all ready to set up in the power-house. A 12 x 12 Sullivan compressor and air-receiver have been purchased and delivered at the mine. The cost of the hydro-electric installation is said to have been about \$13,000, and it is estimated that a further expenditure of \$5,000 is necessary to complete the equipment and construction before machine-drills can be operated.

Just when conditions appeared favourable for carrying out a more progressive policy of development, the property became tied up in litigation and has been idle since the beginning of the year. There have been a lot of exaggerated statements made regarding this property, and although the possibilities of it becoming an important producer appear to be good, it is yet in the prospective stages of development, and future work alone will prove whether it will make a mine or not.

Silver Bell.—Owned and operated by Green Bros., of Kaslo. High-grade silver ore has been mined during the year and a few car-loads shipped to Trail. New and commodious camp buildings were erected.

Silver Bear.—This property adjoins the *Silver Bell* group and was worked under an option by Green Bros.

Flint.—It is reported that E. J. Edwards, of Spokane, has acquired this property from the owner, J. A. Carter, of Kaslo. It is proposed to form a company to carry on mining and development work during the coming year. The claims are located about two miles north of the *Cork-Province* mine, at a fairly high elevation.

Index.—This property, which formerly belonged to Frank Helme, a pioneer miner and prospector of the district, was bonded by E. J. Edwards, and a company backed by Spokane capital and called the Index Mining Company finally acquired the property. A 500-foot crosscut is being driven to intersect the vein at a vertical distance of about 300 feet below the old workings. A small Pelton wheel and compressor were installed. Good progress is reported being made in the tunnel.

OTHER PROPERTIES.

Whitewater.—This mine has been mostly worked under a number of leases, there being about thirty men employed. The shipments for the year will total about 1,000 tons of silver-lead and zinc ore. The company is now doing some work with a view of proving a supposed south branch of the *Whitewater* vein, and the indications in the crosscut are said to be very encouraging. Stringers of clean ore as wide as 6 inches occur in the slates at a point near where the vein is expected to be encountered. W. H. Burgess, of Kaslo, is the manager.

Utica.—T. J. Poyntz and others have been working this mine under a lease. It is reported that in the old workings a rich pocket of high-grade ore was encountered. The Utica Mines, Limited, which owns the property, recently decided to offer 200,000 shares of treasury stock to the shareholders at 10 cents per share in order to meet pressing indebtedness.

Charleston Group.—These claims, which are situated near the *Whitewater* mine, are reported to have been bonded by A. J. Harris to Winnipeg capitalists.

Mercury Group.—W. J. Elmendorff, a well-known mining engineer of Seattle, has bonded those claims, and it is reported that development-work will be started at once.

Kaslo Concentrator.—M. S. Davys has been busily engaged during the year on a series of experiments with the tailings of the old *Whitewater* mill. Although it is understood that the separation and recovery were satisfactory, the values were not sufficiently high to allow profitable operations, and the plant was closed down in November.

Lincoln.—J. H. Thompson, of New Denver, has had a small crew of men working at this property, and is reported to have struck a nice showing of galena.

Mohawk Group.—Situated near the *Utica* and owned by J. Chisholm, of Kaslo, and others. The property was worked during the year, and some 12 tons of silver-lead ore was shipped to Trail.

Helen Group.—Situated at a short distance from Blaylock. English Bros., of Kaslo, were working on the property during the season. Several nice surface showings of galena have been exposed, while in the raise between Nos. 1 and 2 levels an 18-inch to 2-foot streak of soft oxidized material carrying good silver values is exposed; the extent of this ore is somewhat indefinite at present.

Bannockburn.—The development of this property during the year was mostly confined to driving the crosscut tunnel in order to strike the contact between the limestone and schist, along which they expect to develop ore. The claims are situated on Hall creek.

Superior.—Brown Bros. have been actively engaged during the season on this property; the results of the prospecting and exploratory work done have not yet come to hand. The property is situated near the *Bannockburn*.

Comstock-Whitewater Groups.—Situated near the headwaters of Cascade creek at a distance of about ten miles from the railway. The claims were bonded from the original owner, P. J. Sheran, by the Nelson Mining and Development Company, and is incorporated under the laws of the State of Washington. A contract was let for the continuation of a crosscut to intersect the vein at a point below the surface showings. Two men were employed. The ore is silver-lead.

Bullock Group.—Situated within a mile of the railway and at a short distance from Poplar. Exploratory and development work is being done by the Bullock Gold Mines, Limited. The principal values are in gold.

Telluride Group.—Situated within three miles of Poplar and owned by P. Kelly, an old-time prospector and miner of Poplar. Some high-grade gold ore has been extracted from a small vein, which is exposed along a drift near the surface for a distance of about 20 feet. Present work consists of driving another tunnel in order to gain more depth on the vein.

Rio Tinto.—Situated within about two miles of Poplar, this property has been extensively developed by A. Hansen, of Kaslo, who has owned the claims for a number of years. Further work was done in the lower level during the year.

St. Patrick.—This mine, situated near Argenta and belonging to the British Alberta Mining Company, shipped 22 tons of silver-lead ore.

Slocan Mining Division.

SANDON CAMP.

This camp has witnessed a busy season both in mining and construction work, and the future looks bright not only for the mines, but for many of the prospects, in which keener interest than usual is displayed on account of the high price now obtainable for silver.

Clarence Cunningham, whose progressive mining policy, combined with up-to-date methods, has done so much to increase production and encourage the industry, reports that at his various properties the work done during the season has been along the lines of general development. He at present has about 150 men on the pay-roll, and when running at full capacity will employ an additional 100.

No shipments were made from the *Alamo* mill before August; hence the tonnage is very much below the general average.

The following properties were operated by him near Sandon: *Queen Bess*, *Idaho-Alamo*, *Wonderful*, *Sovereign*, and *Silverite*. It is also reported that he recently acquired an interest in *Bluebird* and *Rawdon* claims, which adjoin the *Reco*. Aerial tramways were completed from the *Sovereign* and *Wonderful* to ore-bins near the railway.

Rosebery-Surprise Mining Company, of which J. P. MacFadden is general superintendent, has been active during the year with mining and development work at the following properties:—

Bosun.—Nos. 4 and 6 drifts are being extended.

Surprise.—The only development being done is the advancement of the No. 4 drift.

Ivanhoe-Canadian Group.—The Nos. 4 and 8 tunnels are being advanced.

Noble Five.—The 4-compartment raise connecting the lower workings with the upper is worthy of special mention, it being the largest and one of the longest ever attempted in British Columbia, and its completion without any serious hitch or accident reflects credit on Paul Lincoln, the mining engineer in charge of the property. The size of the rock-cutting is 20 x 7 feet. The length of the raise is 1,000 feet. The two end compartments are used as chutes for ore and waste, while the two centre compartments are equipped with cages for men and supplies. By the development of ore on the lowest level, and also in the intermediate levels, sufficient tonnage is estimated to be available to warrant the erection of the concentrator, which is now nearing completion. This plant is designed by the General Engineering Company of Salt Lake City. The capacity is 100 tons, and the flow-sheet will include jigs, tables, and Callow pneumatic flotation-cells.

The adjoining claims of the *Reco* group were acquired by Jas. Dunsmuir, the owner of the *Noble Five*, and will be developed from the workings of this latter property.

Silversmith.—It is reasonable to expect that, with the recent success which has attended the development, this property will again become a steady and important producer. The large ore-shoot which was developed on the 1,000-foot level during 1918 has now been drifted on at the 800-foot level, and the result of the work establishes the fact that the same ore-body is equally as strong on the eighth as on the tenth level. A considerable tonnage of silver-lead and zinc concentrates was produced during the year.

Rambler-Cariboo.—The adjoining claims, *Jennie* and *Last Chance No. 4*, were recently acquired, which gives an additional 1,700 feet of undeveloped ground on the vein, and according to W. A. Cameron, the manager, it is the intention of the company to prosecute development on the different levels in the newly acquired territory next year. Owing to the unusual dryness of the season the shortage of water seriously interfered with mining and development work.

The development of ore at low horizons, both at the *Noble Five* and *Silversmith* mines, should be an incentive for the investment of capital for the purpose of carrying on exploratory work at lower levels than was ever seriously contemplated in the earlier days of the camp. In this connection it is of interest to note that the ore at the *Noble Five* was developed at approximately 3,000 feet below the apex of the vein, while at the *Silversmith* the 1,000-foot level, on which the large shoot of ore was encountered, is the lowest horizon on which ore has been developed in the Sandon camp.

Ruth.—The principal work being done on this mine is the driving of the long crosscut in order to gain depth on the vein. James Anderson, of Kaslo, has charge of the property, which belongs to the Alexander interests.

Carnation.—A small crew of men is engaged at development-work under the management of G. Clarke.

McAllister.—Situated on the North fork of Carpenter creek at a distance of about three miles from Three Forks. After lying idle for a number of years, the property was acquired by A. R. Grimes early in the year and a crew of eight or ten men put to work. The operating company is called the Slocan Silver Mines, Limited. The season's work is said to have been highly satisfactory. The ore is a "dry" ore, occurring in a strong, well-defined quartz vein. The values are in silver, mostly in the form of grey-copper. Exceptionally rich pockets are occasionally encountered.

Silver Glance.—Situated at a short distance from Bear lake, on the Kaslo-Nakusp Railway. J. W. Power, the owner, is reported to have bonded the property to G. Huston, of Mullan, Idaho. The ore is similar in character to that of the *McAllister*.

Panama.—This property is now being further developed by the owner, H. Giegerich, of Kaslo. It is situated on the same mountain as the last two mentioned properties and is within easy reach of the railway.

Washington and Silver Reef Groups.—Situated on Payne mountain. Work was continued this year by M. C. Monahan.

Granville Group.—This property, which was recently acquired by a syndicate, is being developed under the direction of George Gormley.

There are a number of other properties on which work is being done in this Division, but information regarding same is lacking at present.

SILVERTON CAMP.

This camp has had rather a quiet season, principally on account of the curtailment of the output from the *Standard* mine, although latterly shipments have been greatly increased.

Van-Roi and Hewitt.—These properties were worked by Clarence Cunningham, but did not come up to expectations and ceased as producers fairly early in the season.

According to latest reports nothing is being done at the *Hewitt*, but development is being continued at the *Van-Roi*.

Galena Farm.—This property, which belongs to the Patrick Clark Estate, of Spokane, was worked under lease by James Casey during the early part of the season, but latterly has been closed down.

Echo.—This property was worked under lease by A. L. McPhee and others. About 500 tons of ore was shipped to Trail.

Wakefield.—This property, which is situated on 4-Mile creek and almost opposite to the *Hewitt*, was worked during part of the year by Clarence Cunningham.

Slocan City Mining Division.

Ottawa.—Although this mine was inactive, a considerable tonnage was shipped from the old dumps by P. McGuire and A. L. McPhee.

Republic.—J. W. Evans, of Nelson, and associates, who have recently become interested in this property, have a small crew of men at work and expect to resume shipments shortly.

Anna Group.—The amount of work, and the way in which it has been done, reflects credit on K. Zimmerman, the owner, who has been working persistently at the property for fifteen years. The present developments give promise of its becoming in the near future a steady and profitable producer. A sample across 6 inches at face of No. 2 tunnel ran: Silver, 165.50 oz.; lead, *nil*; zinc, 3 per cent.

L.T. Group.—Situated near the summit of the divide between Springer and Enterprise creeks and at a distance of three miles by trail from the *Ottawa*. The claims adjoin the *Bondholder* group, which is situated on the other side of the summit. D. B. O'Neil, of Slocan City, the owner, has been successful in developing a small but rich shoot of high-grade silver ore. A small shipment made to Trail ran: Silver, 264.5 oz.; lead, 14.9 per cent.; zinc, 7.1 per cent.

Meteor.—This property, which was bought last year by W. A. Buchanan, has been actively operated during the year. A crosscut is now being run to tap the vein at a lower level. During the latter part of last year 32 tons of high-grade silver ore, representing a value of about \$22,000, was extracted from a winze on the No. 5 level.

Black Prince.—A steady but small production has been maintained during recent years. The property has been operated under a lease and bond by J. T. Tipping, of Slocan. One car-load of ore has so far been shipped this year. It is interesting to note that this property was first developed many years ago by Sidney Norman, the editor of the *Northwest Mining Truth*.

Westmount.—Situated on Enterprise creek. The mine was worked by H. D. Lea and partners under a lease. One hundred and two tons of ore was shipped to Trail, which would signify that the season's operations have been successful, for the ore carries high silver values. The average of fifty-two cars shipped by the original owners ran: Gold, 0.049 oz.; silver, 169.82 oz.; lead, 9.39 per cent.; zinc, about 20 per cent.

Nee-pawa.—Situated on Enterprise creek, opposite to the *Westmount*. An extensive programme of mining and development has been planned by the Delia Mines, Limited, which acquired the property this year. A small crew of men was employed at cleaning out the old workings and doing some development-work under the direction of E. F. Roche. Future plans include the erection of a mill and power plant.

Boomerang.—Situated on Enterprise creek at a distance of about two miles beyond the confluence of the North fork. There is reported to be a nice showing of high-grade silver ore at the bottom of a shallow shaft. Further work is being done by Franz Bros. to prove the continuity of the ore by crosscutting.

Royal A Group.—Situated at the head of the North fork of Enterprise creek. About 10 tons was mined last year. The vein is quartz and occurs in a sheared fissure in the granite. The values are principally in silver. A grab sample of the sorted ore for shipment ran: Silver, 118.5 oz.; zinc, 4 per cent. The property belongs to R. Ainslie and D. McCuaig, of New Denver.

Red Mountain Group.—This is a new prospect staked by R. Ainslie and D. McCuaig. It is situated at a high elevation on the east side of the divide between the North fork of Enterprise creek and the South fork of Kaslo creek. Open-cut work has exposed a small quartz vein lying conformable to the strike and dip of the enclosing schists of the Kaslo series. Just below the surface there is a small pocket of highly oxidized material carrying silver values of over 500 oz. to the ton. Below this the vein is nothing more than a stringer of quartz, although only very little of it has so far been exposed. Further work might be done to advantage by surface trenching along the strike and across the formation.

Profit-Miller Group.—Situated at the head of Miller creek at a distance of two miles from the South fork of Kaslo creek. The property is owned by R. Ainslie and D. McCuaig. Very little work has been done on the property. The general geological conditions are complex, due to faulting, shearing, and contacts between the sedimentaries and the granitic rocks. At this particular place there is a shear-zone on the hanging-wall side of which there is a 2-foot streak of talc gouge; on the foot-wall side 6 or 8 inches of ore is exposed in places in a quartz vein. A sample of this ore ran: Gold, 0.08 oz.; silver, 15.9 oz.; lead, 18 per cent.; zinc, 21 per cent. Before spending any large sum of money it would be advisable to prove the existence of ore in sufficient quantity to be of economical importance by the means of surface work or the continuation of the present tunnel.

Virgil & Christina.—These claims belong to Mike Murphy and adjoin the *Royal A* group. High silver values have been obtained from a small fissure-vein in the granite.

Evening Star.—Situated on Dayton creek near Slocan. Owned by Hugh Sutherland, of Winnipeg. William Moore, of Nelson, is in charge of the development, which will consist of crosscutting and drifting on the vein at a lower level. It is reported that a small crew of men is at work.

Nelson Mining Division.

Eureka.—This property, which is situated on Eagle creek at a short distance from Nelson, was acquired by the Inland Mining Company, of Walla Walla, in August, 1918. The *Granite-Poorman* mill was leased, and development at the mine was continued by advancing the main drift in a southerly direction, where a considerable tonnage was developed. Latterly the company took over the *Granite-Poorman* mine and mill. The long crosscut is now being continued at the *Eureka* to tap the vein below the present workings. The mill, which is equipped with 20 stamps and designed for the *Granite-Poorman* gold ore, is being remodelled with a view of making it adaptable for treating the ores of both the *Eureka* and *Granite-Poorman*.

A progressive programme of mining and development work has been planned, and will be carried out under the supervision of J. Clarke Johnstone, the mining engineer in charge. The operating company is called the Vincent Development Company.

California.—This property, which is situated at a short distance from Nelson, has been developed during recent years by Turner Bros. The vein was encountered on the No. 3 level, and good average gold values were obtained across a width of from 3 to 5 feet. This body of ore was sufficiently proved to warrant more extensive operations, and arrangements were consequently made for the leasing of the *Athabasca* mill. About one mile of road was recently completed, connecting the mill with the No. 3 tunnel. Experiments are now being made with a view of determining the additional equipment and alterations necessary to obtain the best results. Conservative judgment has been exercised throughout, and there is every reason to believe that the *California* will soon rank among the important producers of this Division.

Yankee Girl.—Situated at Ymir. Under the management of W. T. McDowell this mine was one of the largest producers in the Division during 1918, but ceased production during the present year, probably owing to the fact that the values are not high enough to allow mining to be carried on under present economic conditions. Presumably it is only a matter of time for financial arrangements to be made for the erection of a concentrator, which is necessary for the future success of this property. There is reported to be ample tonnage available to warrant this additional expenditure. The principal values are in gold, and the production of this mine last year was responsible for an increase in the gold production of this Division.

A great deal of interest has been taken in the exploratory work being done on Sheep creek, the success of which means so much to this camp in particular, and to the gold production of the district in general.

Unfortunately, the work done by A. W. McCune at the *Queen* mine did not come up to expectations and the project has been abandoned. A tunnel was driven for approximately 1,600 feet; at 700 feet from the portal the *Yellowstone* vein is said to have been cut. This was drifted on for about 200 feet, but little values were found.

Motherlode.—This property is situated on Sheep creek at a distance of two miles from the *Queen* mine and on the opposite side of the creek. During 1918 a company called the Nugget Gold Mines, Limited, was organized and an amalgamation was formed between the *Nugget* and *Motherlode* properties. The principal object was to develop the *Nugget* vein by means of a long crosscut from the lower workings of the *Motherlode*, which would not only allow economical working of the *Nugget*, but would also allow the use of the modern and well-equipped *Motherlode* mill on Sheep creek. The crosscut, which will have a length of about 1,200 feet, was started from the No. 5 level of the *Motherlode*, and is now nearing its objective, although a shortage of water during the dry season seriously impeded its progress. The work is being done under the supervision of R. H. Stewart, consulting engineer. Harold Lakes is in charge of the work at the mine.

The fact that the work at the *Queen* has not been satisfactory is no reason for discouragement regarding the *Nugget*; the two cases are not analogous.

Reno.—W. B. Pool has been engaged at prospecting at this property, and has been successful in discovering a new lead. The values are said to compare favourably with those of the *Reno* vein.

Emerald.—A small concentrator is being erected at this mine. Steam-power will be used. The mine, which in recent years has been the only silver-lead producer in the Sheep Creek district, is one of the pioneer properties, and has shipped in the past about 50,000 tons of crude ore. The ore carries a high percentage of lead, low silver, and zinc values varying from about 6 per cent. upwards.

Second Relief.—Situated near Erie. The mill and mine buildings were completely wiped out by bush fires during the summer months. Efforts are now being made by A. D. Westby, the manager, to reorganize the company with a view of acquiring sufficient capital to rebuild the plant. The values are in gold.

Iva Fern.—Situated on Cultus creek. The crosscut which is being driven by J. Mulholland under contract with the Consolidated Mining and Smelting Company is now in 252 feet. The face is in a hard and massive slate formation; hence progress is necessarily slow. Work has been suspended for the winter months.

Spokane Group.—Situated on Canyon creek, in what is known as the Bayonne district. Laib Bros. have been actively engaged in developing the property during the season, and according to reports have built a small arrastra. The values are in gold and silver, the gold predominating.

The British Columbia Iron Company has staked a number of claims near Kitchener, on Thompson creek. The present showings are within six miles of the railway. A crew of men was employed at exploratory work during the season under the direction of George Young, of Creston. Preliminary work, consisting of open-cuts and trenching, has been successful in uncovering ore on either side of the creek, but nowhere has either the width or continuity of the deposit been defined, owing to the rock in-place being covered by a depth of from 10 to 15 feet of overburden, which not only makes prospecting difficult, but adds to the difficulties of determining the nature and possibilities of the deposit. Indications, however, appear to be sufficiently encouraging to warrant further exploratory work by surface diggings, which should be confined to a point where the geological conditions are most favourable for the winning of ore; then, if results are satisfactory, a diamond-drill might be used to good advantage. From analysis the ore is a mixture of hematite and magnetite. A sample taken along a face for a distance of 12 feet gave the following returns: Iron, 52 per cent.; sulphur, trace; phosphorus, trace.

Sullivan Group.—Owned by J. A. Sullivan. Situated near Kitchener at a distance of half a mile from the railway. A quartz vein carrying copper values has been prospected by a number of open-cuts and a shallow shaft. The best showing is at the bottom of the shaft, where a width of 3 feet of ore is exposed. The ore consists of chalcopyrite in a quartz gangue. A sample across a width of 34 inches ran: Gold, trace; silver, 1 oz.; copper, 6 per cent.

Arrow Lake Mining Division.

Millie Mack.—Situating near Burton. This property has been operated for a number of years by the owner, H. E. Forster, of Wilmer. This year there was a small crew of men working, but no information regarding the result of the season's work has yet come to hand.

Chieftain.—This property has been lying idle for some years, but as a result of an examination made by engineers it is understood that the mine will be opened up early next spring. It is situated on Cariboo creek at a distance of about twelve miles from Burton.

Trail Creek Mining Division.

ROSSLAND CAMP.

The official announcement that the Consolidated Mining and Smelting Company intends erecting a large concentrator for the treatment of the low-grade Rossland ores predicts greater activity for this camp than has been experienced for some years.

In spite of the ever-increasing cost of labour and supplies—conditions which are not favourable for the economic mining of low-grade gold ore—the production for the year will compare favourably with that of last year.

At Trail many improvements have been made at the smelter, and the successful experiments made on the magnetic separation of the *Sullivan* ores have gradually led to extensive additions being made to the experimental magnetic separator plant, which now has a daily capacity of about 300 tons.

On June 24th the Consolidated Mining and Smelting Company issued Schedule C, which shows a substantial reduction in smelting charges, amounting to an average of about \$3 a ton on Slocan ores.

On September 26th the company notified the mine-owners that they had decided to change their method of lead settlement by cancelling the old pooling system. The new method of settlement applied to all shipments received at the smelter on and after October 1st.

Mountain Chief.—Situating near Renata, on Lower Arrow lake. Development, consisting of sinking and drifting, has been steadily carried on under the supervision of J. W. Evans, the manager. A 2-bucket tram was erected early in the year, and latterly a 2-drill compressor was installed at the mine. Shipments were recently resumed to Trail. According to recent reports, present indications at the mine have fulfilled the most sanguine expectations.

Revelstoke and Lardeau Mining Divisions.

Beatrice.—After lying idle during recent years, the *Beatrice* was opened up again and the mine-workings put in shape for further mining and development work, which, it is understood, will be carried out under the supervision of Mr. Bodine, who is familiar with the property. Four men have been working since the middle of August. The property is held under bond by a company which was recently incorporated and called the New Era Mines, Limited.

Burniere Group.—Situating near Camborne and owned by C. Menhinick. This property is reported to have been bonded this year and that mining operations will be carried on during next year.

The *Scout*, *Big Showing*, *Oyster*, and *Eva Criterion* properties have been examined by visiting engineers, but no confirmation of any new developments has yet come to hand.

Lanark.—Situating at Laurie, on the main line of the Canadian Pacific Railway. Development-work has been actively carried on under the direction of W. Dornberg. The winze on the No. 4 level has been dewatered. It is reported that conditions are favourable for steady operation during the coming year and that a considerable increase in output is expected.

Woolsey Group.—Situating on Silver creek at a distance of seven miles from the main line of the Canadian Pacific Railway at Albert Canyon. It is safe to say that this property has excited unusual interest during the last two years, and that it has probably been examined by more engineers than any other property in the district.

Although staked some years ago, it escaped attention until Dave Woolsey acquired it in 1917. At this time the old trail was overgrown, and owing to the nature of the country the property was extremely difficult to reach. During the latter part of 1917 a good trail was built to the claims, and in 1918 cabins were erected, trails built to give access to the various showings, and development-work was commenced in the winter months of the year.

The vein upon which the work is being done is strong and well defined, showing unusual persistence along the strike. Besides uncovering the vein at few places along the outcrop, the work done consists of driving a tunnel for 120 feet in the foot-wall parallel to the strike of the vein. At a distance of 74 feet from the portal a crosscut has been driven, showing the vein to have a width, at this point, of 23 feet across $9\frac{1}{2}$ feet, of which a sample gave the following results: Silver, 6.6 oz.; lead, 6 per cent.; zinc, 6 per cent. The gangue material is quartz. The second crosscut is driven from the end of the tunnel, at which point the vein holds its width and is more heavily mineralized with galena, according to reports from the miners. This latter work was not completed at the time of examination by the writer.

The future of the property depends upon the development of sufficient ore to warrant the erection of a concentrator, and, while the indications are favourable for the development of a large tonnage, careful judgment will have to be exercised as to where the work should be done in order to obtain the best results. According to late reports the property has been recently bonded to C. V. Brennan, of Victoria.

Trout Lake Mining Division.

There has been less actual mining activity in this Division than usual, although there has been keen outside interest taken in many of the leading properties, as evidenced by the number of inquiries and the numerous examinations made by visiting engineers, which it is hoped will result in renewed activity during the coming year, for it is certainly a district which has great possibilities.

Old Gold.—This property is situated at a distance of about thirteen miles from Ferguson and at a short distance over the summit, which forms the dividing line between the Trout Lake and Ainsworth Divisions. A small crew of men was working this year, but so far no record of any shipment being made has come to hand. The ore is high-grade silver-lead, and in spite of extremely adverse conditions a considerable tonnage has been packed out from this property.

Crescent.—Situated near the headwaters of 8-Mile creek on the northerly side of Trout lake. Prospecting and development work were continued this year under the management of M. Leahy.

Gold Bug Group.—Situated near the confluence of 7-Mile creek and the South fork of the Lardeau. The claims are owned by J. W. Livingston, of Ferguson, who has diligently carried on development-work for a number of years. This year results obtained were very encouraging, and the conditions appear favourable for opening up ore in commercial quantities. The ore so far developed carries good values in silver and lead.

WESTERN MINERAL SURVEY DISTRICT, No. 6.

PRELIMINARY REPORT BY WM. M. BREWER, RESIDENT ENGINEER.

(Headquarters, Nanaimo.)

INTRODUCTION.

During the past year a steady improvement has been noticeable in the mining industry in this district; not so much in the increase of the production of the coal and metalliferous mines, but because of the fact that the development-work done, especially on the metalliferous properties, has been made to determine the extent and grade of known ore-bodies before attempting to extract ore for treatment. Heretofore there has been too great a tendency to begin shipping before the development-work necessary to determine the extent, grade, and character of the ore has been done, and consequently there has often been a lack of economy and efficiency in working mineral properties.

With the advent of such corporations as the Consolidated Mining and Smelting Company; the Granby Consolidated Mining, Smelting, and Power Company; and several others of equal prominence, into the metalliferous-mining industry of the district, more attention has been directed towards systematic development-work under the supervision of technically trained engineers. During the past year the advantage of such work is evidenced by the results, and designs have been made for the erection of concentrating-mills with a capacity to treat 500 tons of ore a day each at the *Sunloch* mine on Jordan river, also on the *Old Sport* mine at Elk lake, in the Quatsino Mining Division, while the plant on the property of the Tidewater Copper Company on Sidney inlet has been remodelled and improved preparatory to being placed in

commission to treat the ore that has been developed by the work done since the summer of 1918, when the company was reorganized and H. B. Price arrived from New York to take charge of operations.

The conditions with regard to smelting facilities on the Coast have not yet been improved, but there are probabilities that the Ladysmith smelter will be blown in during the coming year. It has been clearly demonstrated that the supply of custom ore at present is insufficient to warrant the operation of a smelting plant dependent entirely on custom ore; consequently the Ladysmith Smelting Corporation has secured a copper-mine on Latouche island, in Prince William sound, south-western Alaska, which it is developing to determine the tonnage of ore available for supplying a regular quantity for treatment. It is reported by the management that the development-work is progressing very satisfactorily, and that the smelter will be remodelled and put into first-class shape during the coming summer, when regular shipments from the Alaska mine are assured. The company has bonded some properties on the Coast which will be developed to furnish a supply of siliceous ore for flux.

A large part of the time of the writer has been occupied during the past year in administering the "Iron-ore Supply Act" passed by the Provincial Legislature in the spring of 1919, which provided for the supply of iron ore for experimental purposes in order to determine the problem of smelting magnetite ore and producing pig-iron in commercial quantities at a cost that would permit of competing with the iron and steel plants in eastern Canada and the United States. Unfortunately, the electric smelters in and around Vancouver carrying on experiments became so tied up in litigation that it was impossible to carry out the beneficent purpose of the Act to any great extent. One demonstration was made by the Vancouver Magnetite (Fe_3O_4) Iron and Steel Smelting Company, of Vancouver, on a small scale, which was witnessed by the Provincial Mineralogist and the writer, and failed to produce results.

The provisions of the Act, however, enabled the writer to make examinations of several deposits of iron ore which were brought to his notice and had not been previously examined, having only been discovered at a comparatively recent date.

The number of prospectors who have been searching for deposits of minerals in this district has been somewhat greater during the past season than during recent years. The sections which proved to be the most attractive to prospectors are in the mountains adjacent to Jervis inlet, on the Mainland; along the line of the Pacific Great Eastern Railway; on the Stawamus river near Squamish; and on the west coast of Vancouver island. Some of the locations staked have quite promising showings of copper ore, usually carrying low values in gold and silver.

On Mount Sicker and Mount Brenton, in the Duncan section of the district, there was activity during the past summer. The old workings on the *Lenora* mine were examined by G. D. B. Turner, M.E., on behalf of clients. As a result of the examination Mr. Turner concluded that there was a probability that the ore-body had been thrown towards the north by a fault; consequently he took a bond on the property and started sinking at a point northerly a short distance from the old workings, and was continuing that work when the writer examined the property on October 13th, 1919.

Prospecting for oil has been continued in the vicinity of Vancouver during the past year by the Spartan Oil Company near Burnaby lake; the Boundary Bay Oil Company at Boundary bay; the Pitt Meadows Oil Company on Pitt Meadows; the Surrey Oil Company near the International Boundary east of Semiahmoo bay; the National Oil Company near Hazelmere; and the Empire Oil and Gas Company near Aldergrove. In addition to these companies there has been a large number of oil companies organized on the strength of leases having been acquired to parcels of land in the Fraser River delta, none of which appear to have accomplished anything definite, although they are selling stock.

PRODUCTION.

The estimated production from the metalliferous mines during 1919 in the district is slightly greater than for the previous year. During 1919 there have been approximately 757,000 tons of copper-gold-silver ore mined, as compared with 745,169 tons in 1918, and the yield from the ore mined in 1919 is estimated at 20,175,000 lb. of copper, 118,000 oz. of silver, and 4,300 oz. of gold. Of course, the bulk of the production from the metalliferous mines is furnished by

the properties of the Britannia Mining and Smelting Company, Limited, on Howe sound, the remainder being from the *Marble Bay* mine on Texada island and the *Ingersoll* mine on Quadra island.

The prospects are that during the coming year the *Old Sport*, *Sunloch*, *Indian Chief*, and probably the *Lucky Four* mines will be added to the list of producing metalliferous mines in No. 6 District.

The production of coal from the district for the past year is as follows:—

Canadian Collieries (Dunsmuir), Ltd. (Comox)	549,513
Canadian Collieries (Dunsmuir), Ltd. (Extension)	310,616
Canadian Western Fuel Co., Ltd.	641,171
Granby No. 1 Colliery, Cassidy	67,735
Nanoose Wellington Coal Co. (formerly Nanoose Collieries Co., Ltd.)	20,803
Pacific Coast Coal Mines, Ltd.	64,147
British Columbia Coal Mining Co., Ltd.	36,739

Total 1,690,724

For the first time in the history of the district manganese ore was shipped from a deposit known as *Hill 60* near the foot of Cowichan lake. The production was 568 tons, which averaged 50 per cent. in manganese and not to exceed 19 per cent. in silica. The shipments went to the Bilrowe Alloys Company, Tacoma, Wash., U.S.A.

Some shipments of talc were made from a deposit on Wolf creek near its confluence with the Leech river and about half a mile from the track of the Canadian Northern Railway, on which steel was laid during the past summer.

Nanaimo Mining Division.

Coal-mining.—As coal-mining is the most important mineral industry in the Western Mineral Survey District, and as all of the collieries are in the Nanaimo Mining Division, the conditions in that Division are being considered first in this report.

There has not been as much really new work started in 1919 as was the case in 1918, but it must be taken into consideration that the development of a new coal-mine is a rather slow process.

The two new producers are the No. 5 mine at South Wellington, the property of the Canadian Collieries (Dunsmuir), Limited, from which coal has been mined on a commercial scale since early in 1919, and the Wakesiah mine on the Wakesiah farm, the property of the Canadian Western Fuel Company, Limited, which began producing commercially about October, 1919.

Amongst new development or prospecting work to be recorded for 1919 there is the diamond-drilling being done by the Canadian Collieries (Dunsmuir), Limited, on the Tsaabl river, which empties into Baynes sound about five miles southerly from Union Bay, in the Comox section; also the reopening of an old slope by the Canadian Western Fuel Company, Limited, on the Wellington seam southerly from the Harewood mine. The slope had been driven about 400 feet and abandoned by the former management. During the past summer the old workings were unwatered and examined, with the result that the general manager, George A. Bowen, ordered that the workings be reopened and extended and the mine placed on a producing basis. This may be worked as the Harewood No. 2 mine, with a new railway connection, or the underground workings may be extended to connect with the haulage system on the Harewood mine and the coal be transported through that mine to the railway system now in use.

Another occurrence of importance in the coal-mining industry in this Mining Division during 1919 was the change in ownership of the Grant mine at Nanoose from the Nanoose Collieries Company, Limited, to the Nanoose Wellington Coal Company, with headquarters at 1010 L. C. Smith Building, Seattle, as well as at 607 Standard Bank Building, Vancouver. The new officers of the company are: President, Louis Williams; secretary-treasurer, John A. Coleman; general manager, Fraser H. Lantz; mine manager, John Johns, who occupied the same position with the old company.

New construction and development work has been in progress since the change of ownership on August 30th last.

The labour conditions in the coal-mines on Vancouver island have been excellent during 1919; the relationship between the companies and their employees was so harmonious that,

despite the efforts made by some of the radical leaders in the Vancouver strike, it was found impossible to promote any discord in the Island collieries. A system of collective bargaining was introduced after the big strike in 1914, by which the miners working for each company elect committees by a pit-head ballot from amongst the employees in the particular mines operated by the respective companies, which committees act as advisory and conciliatory boards between the miners and the company. In this way each individual company treats with its own employees, and new contracts were signed last fall satisfactory to all.

Metalliferous Mining.—As already stated in this report, the only metalliferous mines in the Nanaimo Mining Division that produced during 1919 were the *Marble Bay* on Texada island and the *Ingersoll* on Quadra island. At the former a considerable proportion of the tonnage shipped was mined from the 1,600-foot level, while development both by working-openings and diamond-drilling was done on the 1,700-foot level about 225 feet below the 1,600-foot level on an incline of 45 degrees, which is a vertical depth of 1,600 feet below the collar of the shaft and more than 1,500 feet below sea-level.

On the *Ingersoll* group of mines most of the ore shipped during the summer was taken from the *Senator* mineral claim from near the surface. Later in the autumn new capital was furnished from England and development-work commenced on the *Copperopolis* and *Copper Mountain* claims, belonging to the same group.

Some prospecting has been done in the vicinity of Granite bay on Quadra island, also on parts of Texada island, and assessment-work has been done generally on the metalliferous mineral claims in the Division, but except on Thurlow island, where the Ladysmith Smelting Corporation took a bond on the *Dawn* group, there has not been any development of noticeable importance.

Vancouver Mining Division.

The location of the *Britannia* mine on Howe sound, in the Vancouver Mining Division, attracts the attention of mining men to that section and causes it to be especially attractive to prospectors; consequently, any reports of new discoveries of metalliferous minerals in the Coast range westerly from the *Britannia* mine are received with a good deal of enthusiasm. During 1919 some new discoveries of deposits of copper-sulphide ore are reported near Mount Diadem, westerly from Britain river, which flows into Jervis inlet, also on the Stawamus river near Squamish. Development-work on a limited scale was done on mineral claims located at other points tributary to Jervis inlet, also on the *Opporcol* group on Howe sound, about five miles from Whytecliff, and it was expected that mining and milling operations would have been active on the *Bowena* group on Bowen island during the latter part of 1919 as construction-work was completed.

The *Britannia* mine produced a greater tonnage of ore in 1919 than in any previous year, the estimate being 750,000 tons delivered to the concentrating-mill, which yielded approximately 20,000,000 lb. of copper, 110,000 oz. of silver, and 3,200 oz. of gold. During certain months in the year there was a production of more than 2,000,000 lb. of copper a month.

A full description of the development-work underground during the past year, which aggregates about two miles of working-openings in addition to diamond-drill boring, will be included in the Annual Report of the Minister of Mines for 1919. In this preliminary report attention is called to the fact that there are reserves of "actual" ore blocked out to the extent of 9,000,000 tons, which will average 2 per cent. in copper. So far as ore that is considered as "probable" and "possible" is concerned, no estimate is ever attempted.

The labour conditions have been excellent, and the management has exhibited a strong desire to Canadianize the labour employed, both in the mine and mill, by giving preference to returned men from overseas and to British subjects. "About 350 returned men are in the employ of the company, and are giving perfect satisfaction," was the statement of E. J. Donohue, secretary-treasurer, to the writer at the time of his visit on October 24th, 1919.

New Westminster Mining Division.

Except on the *Lucky Four* group of mineral claims on the Cheam range, about fourteen miles southerly from Laidlaw Station, on the Canadian Northern Railway, there has not been any development worthy of special note on the metalliferous mineral claims located in the New Westminster Mining Division during the past year.

Underground development-work has been energetically carried on by A. S. Williamson, superintendent for Sperry & White, of Seattle, who own the *Lucky Four* property, and the pack-trail from Laidlaw to the portal of the main adit on the southerly slope of the range has been repaired and a portion of it newly constructed last summer. The Provincial Government contributed 50 per cent. of the cost of the work on the trail.

Prospectors reported late in the year the discovery of extensive deposits of low-grade copper-sulphide ore near the shore of Chilliwack lake, south-easterly from the *Lucky Four* group; also on Ford creek, which flows into the Chilliwack river near the foot of the lake.

Victoria Mining Division.

The Victoria Mining Division in the near future will have within its boundaries a mine producing on a large scale, as the Consolidated Mining and Smelting Company has acquired a controlling interest in the *Sunloch* group on Jordan river, where the underground development has resulted so satisfactorily that the company has concluded to install a concentrating-mill to treat 500 tons of ore a day.

This property has been systematically developed since the spring of 1917 under the superintendence of R. H. Stewart, of Vancouver. A detailed account of the development-work will be included in the Annual Report for the current year.

There has not been any extensive development-work done on many of the other mineral claims in the Victoria Mining Division during 1919, and in this respect the progress of the industry has been somewhat disappointing.

A group of mineral claims on Mount Brenton was bonded during the past summer by L. Levansaler and associates, of Tacoma, who commenced systematic development-work in order to determine whether or not it was advisable to complete the purchase. This work is still in progress.

The Leech River section of the Victoria Mining Division has received attention during 1919 owing to the occurrence of a deposit of talc of good quality, for which the paper-mills have created a market.

So far the only deposit of talc which has been developed to any extent is that on Wolf creek, a tributary of Leech river, with the junction near old Leechtown. The deposit has been crosscut for about 30 feet, but this does not show the full width, nor has the length been yet determined.

Other deposits of talc occur in the Leech River formation, which will probably be developed now that a local market is assured and rails are laid on the Canadian Northern Railway, the track of which is only a short distance from the occurrences. By this means a new industry is assured to the Province.

The development of the manganese-deposit known as *Hill 60* near Cowichan lake is of much importance, as the shipments already made have proved so satisfactory in the market, although shipments have had to be suspended until an aerial tramway is installed. An incentive is thus created to develop the other known deposits on Shaw creek near the head of Cowichan lake.

Alberni Mining Division.

Big I. Group.—There has been but very little activity in the mining industry during the past year in the Alberni Mining Division, but the future prospects look decidedly bright owing to the news that the Consolidated Mining and Smelting Company has taken a bond on the *Big I.* group of mineral claims about ten miles from the head of Great Central lake. This group is better known as the *Big Interior* group, located in 1899.

Clayoquot Mining Division.

Mining operations in the Clayoquot Mining Division have been principally confined to development-work on the *Indian Chief* group of mineral claims on Sidney inlet by the Tidewater Copper Company under the general management of H. B. Price. The underground workings have been extended about 600 feet; the mill at the beach has been remodelled, its capacity being increased to treat 200 tons of ore a day, and water-power developed to run the mill, compressor, and electric-light plants.

A new ore-body has been discovered on the northerly side of the mineralized zone, which has been crosscut for about 80 feet to November 4th, 1919, with the face still in ore that assayed 2.62 per cent. in copper. From a point 30 feet from the portal to the face on the date mentioned the ore averaged 3.96 per cent. in copper from samples taken every 5 feet and assayed by W. Warren, the superintendent.

Assessment-work has been recorded on a number of mineral claims on Kennedy lake, Deer creek, Elk river, and Flores island during 1919, and there appears to be a good prospect for resumption of work on the *Ptarmigan* group at the head of Bear river, Bedwell sound, which has been idle since the beginning of the war, when the entire staff left for service in the army. Recently Mr. Johnson, the chief mining engineer, returned to Canada and visited the property, but no move has yet been made to resume work.

The results from limited development-work on the *White* group of mineral claims on Deer creek and the *Wanderer* group near the head of Kennedy lake are very encouraging, and show that both groups are well worthy of thorough and extensive development.

Quatsino Mining Division.

Except the regular assessment, no work has been done on mineral claims in the Quatsino Mining Division, and there has not been much activity in the mining industry during 1919.

Old Sport Group.—Development-work has been vigorously carried on by the Coast Copper Company, Limited, under the supervision of William Clancy, who has been manager of the property for the past several years; in fact, has superintended all of the development-work done to date. The group contains about forty mineral claims on Elk lake, about midway between the South-east arm of Quatsino sound and Nimpkish lake. The work was interrupted during the summer by a fire which destroyed the compressor, power, and electric-light plants, but the damage was repaired as rapidly as possible, the ruined plants being replaced by more modern and up-to-date ones with increased capacity.

The actual development-work in the mine has been confined to diamond-drill borings along the outcrop, aggregating 7,000 feet, and driving a main adit at a lower level to intersect the ore at a vertical depth of about 500 feet below the outcrop. This adit when finished will be about 2,000 feet long.

A concentrating-mill has been designed which will be erected during the coming year, when it is expected that a railway will be constructed to transport ore and concentrates to tide-water, a surveyed distance of about sixteen miles.

Millington Group.—This group of six mineral claims is on Spruce river, which flows into the head of the West arm of Quatsino sound. The property is about three miles up the river from Holberg Post-office, at the head of the West arm. There has been only prospecting-work done to date, but the showing is very promising. The ore is chiefly bornite and quite a proportion of some of the outcroppings will assay above 15 per cent. in copper.

Iron Ores in Clinton Mining Division.

During part of August and September the writer was engaged in examining deposits of bog- or limonite-iron ore in the vicinity of the Taseko (Whitewater) river and lake, in the Clinton Mining Division, outside of the Western Mineral Survey District. This examination was undertaken in compliance with the instructions of the Honourable Minister of Mines in conjunction with carrying out the provisions of the "Iron-ore Supply Act," as the occurrence of such extensive bodies of this class of iron ore as had been reported was considered to be of great importance with reference to the establishment of an iron and steel industry in the Province.

The examination determined that within an area of about twenty-five square miles that was covered by the reconnaissance on the easterly border of the Coast range there occur several deposits of bog- or limonite-iron ore in basalt and other volcanic rocks of Tertiary age. These occurrences are found under geologic conditions which are not usually associated with this type of iron ore; in fact, in Kemp's "Ore Deposits in the United States and Canada" there is only one reference to similar occurrences. This is on page 92, where he describes the *Prosser* mine near Portland, Oregon, as: "Deposits of limonite in the superficial hollows of a Tertiary basalt of the Cascade range." He says further: "Similar bodies of limonite resulting from basalt are known in the German province of Hesse and in Ireland."

It is impossible to determine the quantity of iron ore contained in the Taseko River deposits because there has been no development-work done, but there is hardly any question but that, roughly estimated, there is possibly 50,000,000 tons of iron ore within the boundaries of the area examined, much of which can be mined with a steam-shovel.

The assays made from samples taken during the examination show that the ore contains from 41 to 50 per cent. metallic iron; that four out of nine samples contained only traces of phosphorus, one sample 0.04 per cent., and the remaining four 0.23 per cent., 0.21 per cent., 0.52 per cent., and 0.85 per cent. respectively. The sulphur content varies from 0.44 to 2.46 per cent.

VICTORIA, B.C.:

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.
1920.