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BUREAU OF MINES REPORT

ON

HAZELTON-TELKWA DISTRICT

A PORTION OF THE

OMINECA MINING DIVISION

BY

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1917.

To the Hon. William Sloan,

Minister of Mines, British Columbia.

SIR,—I have the honour to submit herewith a Preliminary Report on the Mineral Resources of the Hazelton-Telkwa District, a portion of the Omineca Mining Division, by John D. Galloway, Assistant Mineralogist, prepared this season under instructions for the Bureau of Mines.

I have the honour to be,

Sir,

Your obedient servant,

WILLIAM FLEET ROBERTSON,

Provincial Mineralogist.

Bureau of Mines, Victoria, B.C.,

February, 1917.

HAZELTON-TELKWA DISTRICT,

A PORTION OF THE

OMINECA MINING DIVISION.

PRELIMINARY REPORT BY JOHN D. GALLOWAY, ASSISTANT MINERALOGIST.

INTRODUCTORY.

DURING the summer of 1914 the writer spent two months and a half in the Hazelton-Telkwa region of the Omineca Mining Division, examining a number of the more important mineral properties and noting the general geological and physical features. The report on this was issued as Bulletin No. 4, 1915, and was also printed in the Annual Report of the Minister of Mines for the year 1914. The writer's main work during the summer of 1916 was to make a reconnaissance of the country south of the Grand Trunk Pacific Railway, and following, to some extent, the eastern contact of the Coast range south to Bella Coola. While this was the route laid out, it was impossible to adhere to it strictly owing to lack of trails.

Before commencing on this reconnaissance trip one month was spent in the Hazelton-Telkwa region, noting new developments and examining some new camps. A number of the properties examined in 1914 were revisited and several new ones were examined. While the previous report on the Omineca Division was incomplete in many respects, it is, nevertheless, not felt that it is necessary to here recapitulate the introductory, historical, and general descriptive matter given at the commencement of that report, and to it the reader is referred for such information. This report will also avoid, unless where absolutely necessary, any description of work done prior to 1914, which is given in the 1914 report.

The main idea of this present report is to present as simply and clearly as possible a description of mining operations in this region during the past two years, together with, wherever possible, opinions in regard to the origin of the ore-bodies and information about the general geological features. It should be remembered, however, that, in examining about thirty properties in one month scattered over a distance of 150 miles, but little time is allowed for detail examination, and that the statements in regard to the geological features fall strictly into the category of "notes."

A word may be said here in regard to assays. It is, of course, impossible that a Government engineer can take as many samples from a property as would a private engineer examining an individual property for purchase or sale. The writer has many times been told that one or two samples taken from a property are misleading and that it is better that none should be taken. To this view he cannot agree, as even one sample, if intelligently taken, will indicate the nature of the ore; at the same time the writer thinks that in all cases it should be made very plain just what the sample represents.

It is a pleasure for the writer to express his appreciation of the kindness and courtesy shown to him by the residents of the district. The ready assistance given to him by the prospectors and mining men greatly facilitated the work of examination.

SUMMARY AND CONCLUSIONS.

The territory embraced in this report may be best described as the Hazelton-Telkwa section of the Omineca Mining Division.

Some confusion exists in regard to the name "Omineca" which it seems best to clear up. The Omineca Mining Division is an arbitrary division made some years ago, as were other mining divisions, in order to divide the Province up into districts for administrative purposes. It so happens that this Omineca Division, which contains some 58,000 square miles, includes the Hazelton-Telkwa region, and also a placer-mining region distant some 100 miles from Hazelton which is generally known as "The Omineca." Popular custom in the Hazelton-Telkwa section limits the name Omineca Mining Division to the placer country only, but it should be remembered that it takes in, as outlined above, a much larger district, including the active lode-mining camps along the Skeena and Bulkley rivers.

Lode-mining in the Hazelton-Telkwa region may be said to have had its commencement about 1902, but little headway was made until 1913.

The following table of mineral output shows how mining has grown in the last few years:—

METALLIFEROUS OUTPUT OF THE OMINECA MINING DIVISION FOR THE YEARS 1913 TO 1916.

	1913.		1914.		1915.		1916 (estimated).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold, placer	300 oz.	$ 6,000	300 oz.	$ 6,000	600 oz.	$ 12,000	600 oz.	$ 12,000
Gold, lode	62 "	1,281	203 "	4,196	1,524 "	31,501	1,200 "	24,804
Silver	46,298 "	26,297	135,265 "	70,473	79,155 "	37,361	112,635 "	70,271
Lead	156,862 lb.	6,165	323,482 lb.	11,322	249,279 lb.	10,395	224,451 lb.	13,849
Copper	1,838 "	281	6,000 "	816	2,831,279 "	489,245	1,619,145 "	440,407
Zinc	...	...	...	...	...	...	168,616 "	18,345
Total values	...	$40,024	...	$92,807	...	$580,502	...	$579,676

During the summer of 1915 the Canadian Geological Survey carried out further work in the vicinity of Telkwa river. This work was done by J. D. MacKenzie, and a short preliminary account of his observations is given in the Summary Report of the Geological Survey for the year 1915. His final report has not appeared yet.

The 1914 report of the writer contained a bibliography of the reports on the district up to that time. This list is reproduced here, together with the additions since that time:—

Name of Author.	Publication.	Year.	Page.
Dr. Geo. Dawson	Geological Survey of Canada	1888	73B
R. G. McConnell	" "	1894	5C
W. Fleet Robertson	Minister of Mines' Report	1905	89
"	" "	1906	101
"	" "	1908	66
"	" "	1911	95
"	" "	1912	65
W. W. Leach	Geological Survey of Canada, Summary Report	1906	35
"	" " "	1907	19
"	" " "	1908	41
"	" " "	1909	61
"	" " "	1910	91
G. S. Malloch	" " "	1911	92
R. G. McConnell	" " "	1912	55
G. S. Malloch	" " "	1912	69
"	" " "	1912	103
W. M. Brewer	Minister of Mines' Report	1914	101
John D. Galloway	" "	1914	176
J. D. MacKenzie	Geological Survey of Canada, Summary Report	1915	62

Mining in this district now seems to be in a healthy condition and promises well for the future. It is true that as yet there are only two important shippers—the *Rocher Déboulé* and the *Silver Standard*—but the encouraging thing is that development-work is being carried out in many places, and the writer has no hesitation in expressing his conviction that many of these properties now being developed will eventually become productive mines. As such properties are described farther on in the body of the report there is no need to enumerate them here.

As a rule, the ore-bodies in this district may be considered as small bodies of medium to high-grade ore as distinguished from the large low-grade ore-bodies found in other parts of the Province. For this reason this section should prove attractive to small mining syndicates and individual operators, as such large amounts of capital are not required as in developing and equipping large low-grade mines. At the same time, it may be pointed out that any form of mining is an expensive business, and that even a small mine requires quite an initial outlay. A prospect which gives promise of developing into a small high-grade mine can usually be tested out with a small expenditure, and in such a case, if successful, returns on the investment come quickly.

The writer would like to reiterate and to emphasize that this district contains a vast area which is as yet virtually unprospected, and which can be classed as a distinctly promising field for exploration. The whole Babine range, which has not been much prospected as yet, would seem to be a likely section in which to find minerals in paying quantities. A large tract of country which should be a likely field for prospecting lies in the "big loop" of the Grand Trunk Pacific Railway from Copper City to Telkwa. This territory is drained by the Zymoetz, Kitsequekla, and Telkwa rivers and many smaller streams; the country adjacent to these rivers has been run over, but much still remains back from the main streams which has scarcely been looked at.

In the mountains on both sides of the Skeena river below Pacific Station the rocks of the Kitsalas series are of frequent occurrence. In this formation many showings of copper ore have been discovered, but as a rule they are irregular and not continuous. It is possible, though, that some of these may later be shown to have enough copper minerals disseminated through a large area of rock-matter to constitute a large low-grade ore-body.

GENERAL GEOLOGY.

The writer is unable to add anything of material importance to the geology as outlined in his 1914 report, which statement then was largely a compilation from the published works of the Geological Survey on the district. A complete geological study and geologic and topographic map of the Rocher Déboulé mountains would be of very considerable value in assisting mining in the district. The main formations of the district have previously been outlined and no change in the former description of them is to be made.

In the Hazelton-Telkwa region the important rocks are the great series of pyroclastic, effusive, and sedimentary rocks called the Hazelton formation, the intrusive granitoid rocks known as the Bulkley eruptives, and the sedimentary, coal-bearing Skeena formation.

The first two are important as being the home of the metalliferous minerals and the Skeena formation for its coal-seams. It would be well for prospectors to make themselves familiar with these rocks in order to prospect more intelligently.

The rocks of the Hazelton formation consist of quartzites, argillites, and schists, as well as partly altered volcanics which were originally andesites, rhyolites, diabases, basalt, porphyrites, breccias, and a third class of ash rocks and tuffaceous sedimentaries. Where these rocks have been sheared, sheeted, fissured, or crushed, mineral deposits have in some cases been formed. This shearing, etc., and subsequent mineralization have apparently been caused by the intrusion of the granitoid rocks known as the Bulkley eruptives. Mineralization has generally, but not

always, taken place in the Hazelton formation rocks at points not far distant from the granitoid rocks. Mineralization in the granitoid rocks is also of frequent occurrence, generally in fairly definite veins. The close relationship between ore-bodies in the Hazelton formation rocks and the granitoid rocks and in contacts between these rocks is the main reason for supposing that the intrusion of the granitoid rocks was the main cause of the mineralization throughout the district. It is evident, though, from the occurrence of ore-bodies wholly within the granitoid rocks, that mineralization—that is, the circulation of mineralizing solutions—was the last phase of the granitoid intrusions. Very probably the intrusion of these rocks set up stresses and strains in the older rocks, causing shearing and fracturing, thus providing suitable places for the deposition of minerals when the last or mineralizing phase of the intrusion took place. Probably also the ore-bodies, now found in the granitoid rocks, are filling fractures and sheared zones formed in those rocks by the partial cooling of the magma which took place before the mineralizing phase commenced. In some cases apophysal dykes thrown off from the main batholiths of granitic rock are apparently responsible for the introduction of mineral to the older rocks, and in several instances these dykes are mineralized. Dykes such as these represent the culminating phase of the intrusion, and are probably either contemporaneous or but slightly antecedent to the mineralizing phase.

The Bulkley eruptives are granitoid rocks, the most common variety being granodiorite, but true diorite or quartz diorite is often seen. Wide variations in composition and texture are found in different places, but at all times the rocks are easily indentified. In dyke form acid phases are common, such as felsite and granite porphyrys. The texture is as a rule granular, but porphyritic facies are common.

For the prospector the important thing to remember is that the most likely place to find ore-bodies is near the contacts of the two rocks and also within the granitoid rocks. The two series of rocks are well shown on Rocher Déboulé mountain; the core of the mountain is granodiorite, and this rock is exposed on the surface in many places, having been exposed by the erosion of the overlying quartzites.

The Hazelton formation, consisting here mainly of quartzites, is represented by patches, some of great size, which are the remnants of the rocks intruded by the granodiorite and which at one time completely surrounded the granodiorite core.

Throughout the district many different types of ore-bodies are found. Under the heading of the *Rocher Déboulé* mine will be found a discussion of the ore-bodies on that property. They are listed as replacement veins in sheared fissure-zones and are of special importance as being typical of a number of such deposits in the district.

The ore-bodies found on Glen and Nine-mile mountain belong to the true-fissure vein type, and the tendency often noted in other districts of a number of parallel quartz veins is well exemplified at the *Silver Standard* mine.

In the western part of the Division remnants of the Kitsalas formation are found. These rocks are older than the Hazelton formation and consist of a highly altered complex of volcanic, intrusive, and some sedimentary rocks. The formation is intruded, and over large areas obliterated, by granitic dykes and stocks of granitic rock belonging to the Coast Range batholithic rocks.

The deposits in the rocks of the Kitsalas formation on St. Croix, Legate, and other creeks are of an irregular nature and correspond more closely to mineralizations in sheeted zones and along dykes than to anything else. In one way they may be listed as replacement deposits, as the mineral was formed by the metasomatic replacement of the country-rock. In the Babine range the prevailing ore-bodies are of the vein type, but some contact replacement deposits also occur. The Dome Mountain properties have well-defined quartz-filled fissure-veins.

The Hudson Bay mountain, Hunter basin, Howson basin, and other deposits are replacements in altered rocks of the Hazelton formation and intrusive dykes, and are directly connected with not-far-distant intrusions of granitoid rocks.

MINERALOGY.

Throughout the Hazelton-Telkwa region the mineralization may be broadly divided into two groups which, however, grade into one another. One may be called the copper-gold group and the other the silver-lead-zinc group. The predominating minerals in the first group are chalcopyrite, pyrite, arsenopyrite, pyrrhotite, and bornite; the last mineral in most cases probably being of secondary origin. In this group the predominating value is, of course, copper, but where arsenopyrite is plentiful and chalcopyrite of lesser importance, then the gold values become of greatest importance. It is evident from many samples taken by the writer during two seasons that arsenopyrite in this district almost invariably carries good gold values. This mineral should therefore have more particular attention paid to it by prospectors than it has in the past. Silver occurs with this group of minerals generally in association with low gold values in the chalcopyrite, but as a rule it is of very minor importance. In some instances high gold values (i.e., up to 6 oz. to the ton) are found in the chalcopyrite, while some gold is often associated with the pyrite. Pyrrhotite as a rule is valueless, and although several specimens have been tested for nickel, no appreciable nickel percentages have been noted. In one or two instances cobalt bloom (erythrite) has been noted and cobalt percentages up to 3 per cent. have been found.

This cobalt would seem to occur in the arsenopyrite, probably isomorphously replacing some of the iron. It is not likely that this is a mineral distinct from arsenopyrite, but when cobalt occurs in quantities from 4 to 10 per cent. in arsenopyrite, then the distinguishing name of danaite is sometimes applied to it.

The secondary minerals belonging to this first group are bornite, chalcocite, native copper, and native silver. A little specular-iron ore (hæmatite) is also sometimes noted.

The minerals found in the second group are galena, sphalerite (zinc-blende), tetrahedrite (grey-copper), stibnite, and very subordinate amounts of chalcopyrite, pyrite, arsenopyrite, and native silver. Of these the first two are the most important. The galena, of course, carries the greater proportion of the silver values found in the ores of the district, but the ratio of silver to lead in this galena varies within wide limits. As a rule, the silver will run at least 1 oz. to the unit of lead, but higher and lower ratios than this are common. Sphalerite occurs nearly everywhere in association with the galena, but it is as yet of minor importance. This mineral is plentiful in the *Silver Standard* mine, the silver-lead shipments from that property running from 15 to 20 per cent. zinc. In shipping this ore to a lead-smelter zinc is a decided detriment, as any zinc above 8 per cent. is penalized at 50 cents a unit. This year, however, a start has been made in sorting out the zinc ore so as to make a product running 40 to 45 per cent. zinc and also carrying 40 to 60 oz. of silver to the ton; about 200 tons of this class of ore was shipped to United States zinc-smelters.

As a rule, the zinc-blende does not carry much silver, and in many instances the silver values are negligible.

Tetrahedrite occurs in sparing quantities in many places associated with galena and sphalerite. It nearly always carries high silver values, and is therefore of considerable economic importance. A little of it scattered through the galena often causes higher silver assays to be obtained than the average run of the galena will give.

Stibnite is found principally in the claims on Nine-mile mountain, in association with galena and subsidiary amounts of sphalerite. It has not yet been found in large enough quantities to make it valuable for its antimony contents, but it, as a rule, carries about as high silver values as the galena does, and is therefore shipped with the lead ore.

Chalcopyrite, pyrite, and arsenopyrite and oxidation products therefrom are sometimes found in very small quantities with the silver-lead-zinc ores, but are of

no economic importance. Native silver is occasionally found in the upper portions of the ore-bodies, having been formed in a secondary manner.

This broad classification into two kinds of mineralization must be accepted as only general, as, for instance, at the *Fiddler* property the ore is a complex mixture of chalcopyrite, pyrite, galena, and some zinc-blende, thus showing a joining together of the two types. Here the principal value is in gold, but silver, lead, and copper values are also quite noticeable.

Sufficient information has not yet been obtained to be able to say whether the two different types of mineralization represent two different epochs of mineralization, but the writer is of the opinion that the two were not separated by any great time period.

Some molybdenite and tungsten have been reported from claims on Mud creek, Rocher Déboulé mountain, but sufficient development has not been yet done to prove whether or not they occur in commercial quantities.

Gold is found in quartz veins in the Dome Mountain camp, probably occurring partly in the quartz and partly in association with pyrite in the quartz.

Oxidation of the surface outcroppings of veins and ore-bodies is of common occurrence throughout the district. Some of the veins are very thoroughly leached out on the surface. This oxidation, however, rarely extends downward more than 10 to 30 feet, and often only a foot or two. Secondary enrichment is practically absent.

The *Santa Maria* property, in Howson basin, has a vein in which the valuable mineral is mainly chalcocite, but in addition there is some bornite and smaller amounts of chalcopyrite. It is quite probable that here the higher sulphides of copper are of secondary origin, having been formed from primary chalcopyrite.

DESCRIPTIONS OF MINERAL PROPERTIES.

In describing the various claims visited, they are given in geographical order from west to east, going easterly along the Grand Trunk Pacific Railway. First of all, several properties west of Hazelton were examined, starting with the *Autumn* group at Amsbury, then the *Diamond* group at Pitman, properties on Legate creek, the *Fiddler* group on Fiddler creek, and claims on Skeena mountain.

In the vicinity of Hazelton all the properties which were being worked were examined, besides some other claims. Next came the coal property at Seaton, some twenty miles beyond Hazelton.

From Telkwa a number of camps lying at some distance back from the railway-line were examined; these included Howson basin, Cronin's camp, and Dome mountain.

Autumn Group. This group is situated five miles west of Amsbury Station and about half a mile north of the railway-track. It is owned by Edward Chesley, Philip Chesley, Geo. W. Kerr, Samuel Alger, and Harry McMann, and consists of the *Autumn No. 1*, *Autumn No. 2*, *Happy*, *Wellington*, and *Lottie M.* claims. Amsbury Station, a flag-station on the Grand Trunk Pacific Railway, is eighty-five miles east of Prince Rupert. The property has a good cabin on it and the workings are only a few hundred feet away.

The rocks exposed on these claims are volcanics and sediments, all considerably metamorphosed, and belonging to the Kitsalas formation. Granitic dykes of a later age cut these rocks, but are not numerous. The volcanic rocks are generally light-coloured and consist of porphyrites, andesites, and volcanic tuffs and breccias. These rocks are, in places, so highly altered as to make it quite impossible in the field to determine just what they are. They are characterized by an abundant development of epidote and chlorite. While as a rule these altered volcanics are of an acid type, some of them are dark-coloured and basic in composition.

The sedimentary part of the Kitsalas formation is here represented by a band of crystalline limestone—practically marble—which has quite a distribution, and by a light-coloured rock which may be a tuffaceous quartzite, but is possibly a true

volcanic ash bedded under water. This limestone-deposit was taken up by the Western Canada Portland Cement Company a few years ago with the intention of developing a Portland-cement industry at this point. A synopsis of the report of W. E. Lossee to the holding company is given in the Annual Report of this Department for the year 1914, page 152. This report shows the limestone-band to have a width of 400 feet and a length of four miles. An analysis of it shows that it is highly suitable for cement purposes. Abundance of shale and clay is also available on the property, which is held by a number of leases, all of which have been surveyed.

This band of limestone is apparently overlain by the volcanic rocks, although the crumpling and folding to which the region has been subjected has, in places, transposed the regular order. It seems rather peculiar that this body of limestone has not been mineralized to some extent by the mineralizing action which has taken place in the volcanics. Limestone is a particularly easily soluble rock, and as a rule lends itself more readily to metasomatic and replacing processes than igneous rock. However, as far as is at present known, this limestone does not carry any metalliferous minerals, but further prospecting of the contacts might discover some.

The showings of ore on this group are confined to a greenish-coloured, highly altered volcanic rock. It is impossible to say definitely what it originally was, but it was evidently of medium acidity, possibly a porphyritic andesite. It now consists of epidote, chlorite, and silica.

The rocks here show considerable fracturing, there being many lines of schistosity developed. Mineralization has taken place along these lines of shearing, and also particles of mineral are disseminated through the unsheared rock. This mineralization is, however, slight, and only in a few places is there much of the rock sufficiently mineralized to constitute pay-ore. Pyrite and chalcopyrite are the principal minerals, with some thin films of bornite developed by oxidation of the chalcopyrite.

Description of Workings.—A tunnel 80 feet long, a surface cut with a shaft from it 10 feet deep, and a smaller open-cut constitute the principal workings on the property. The large cut shows a little mineralization, and in the shaft there is at the bottom a band of rock 2½ feet wide which is fairly well mineralized. The best ore taken out from this open-cut and shaft has been roughly sorted out and piled into a dump which contains about 10 tons. An average sample of this was taken which returned the following assay: Gold, trace; silver, trace; copper, 1.5 per cent.

The small open-cut contains the best showing of ore on the property. In this working there is a width of 10 feet which shows mineralization; a sample cut across the full width assayed: Gold, trace; silver, 0.4 oz.; copper, 1.9 per cent.

The tunnel was driven from a point 40 feet below the large open-cut in a direction N. 63° W. (mag.). At a point about 60 feet in it is underneath this cut and has been continued 20 feet farther. At a point 66 feet in the tunnel a crosscut has been driven to the right for 15 feet, which brings the face approximately under the small open-cut in which the 10-foot width of ore is exposed. The tunnel development has proven disappointing, as practically no mineralized rock was encountered in driving it.

Development-work with one or two men was carried on during the summer and fall, and a letter from one of the owners says that this work disclosed more ore, and that it had been satisfactory.

Diamond Group. This group, owned by Stanley Ross & Sons, and consisting of the *Ruby*, *Diamond*, *Earle*, and *Rainbow* claims, is situated on Hardscrabble creek a short distance above the Grand Trunk Pacific Railway. The trail to the property, which leaves the railway about half a mile from Pitman Station, is about one-third of a mile long.

The property was staked two or three years ago; since then some development-work has been carried out and a 10-ton shipment of ore was made to the Anyox smelter during the summer of 1916. A comfortable cabin has been built on one of

the claims; this is at an elevation of 560 feet, while the workings are 100 to 200 feet higher. The elevation of Pitman Station is 337 feet and it is situated 114 miles east of Prince Rupert.

The outcrops of ore and workings are situated on the east bank of Hardscrabble creek at a point where the creek flows through a rocky canyon with sides nearly 200 feet high. The main showings are on the edge of, and down the side of, this rocky wall, and the remainder are back a short distance where the land surface is comparatively flat. The property is nicely situated for economical working, as it could be developed for a time by tunnel-working, and also is practically on the railway-line.

This property is situated in a district where the predominating formation is that known as the Kitsalas formation, a highly altered complex of intrusive, pyroclastic, and volcanic rocks. Locally the rocks showing are diorite, felsite, and some highly altered volcanic rocks. This diorite and felsite probably belong to the intrusive stocks of granitic rocks, which are contemporaneous with the Coast Range batholithic rocks, and have a widespread distribution in the western part of the Omineca Mining Division.

The volcanic rock is mainly diabase, which, however, has been profoundly altered to chlorite, epidote, and talcose material. There are lines of shearing which run through all the rocks and which have produced a schistose structure along certain zones; slickensiding seen here denotes some movement along these lines of shearing. The felsite has apparently been intruded as a large irregular dyke and carries in it inclusions of the diorite and also of the Kitsalas formation. This felsite is probably a later intrusive dyke which has smashed across the older rocks and incorporated fragments of them which the molten magma was unable to assimilate before cooling. These fragments have therefore preserved their identity, but have at the same time been considerably altered in chemical composition. This felsitic rock is important economically, inasmuch as the showings of ore on the property are confined to it. The local name for this felsite is "pink quartz."

The ore-bodies which have been formed in this felsite are somewhat irregular, and the writer was unable to determine just how they occurred. The ore is developed along cracks and seams in the felsite, but no definite system of shearing or fissuring could be determined. The widest of these mineralized seams is about 1 foot wide, and in this there is a considerable percentage of chalcopyrite and a little bornite. These seams are not continuous for more than a few feet and most of them are irregular and disjointed. The felsitic rock is jointed along a direction N. 65° W. (mag.) and also in a direction approximately north and south (mag.). The general strike or direction of the felsite is also N. 65° W. (mag.).

The origin of the ore would seem to have been by means of a replacing action from mineralizing solutions flowing along cracks in the felsitic rock. Chalcopyrite is the main mineral present, but some bornite has been developed by secondary action from oxidation of the chalcopyrite. Gold and silver values are practically negligible.

The main working on the property is a large irregular-shaped cut which is roughly 20 x 20 x 20 feet. In this cut felsitic rock and porphyritic diorite are very much mixed up and a certain amount of mineralization can be seen. Specks of chalcopyrite are scattered indiscriminately through the diorite and felsite, but not in sufficient quantity to constitute commercial ore. In addition, there are a few seams which contain a larger percentage of chalcopyrite. None of these seams or veins are of sufficient size or regularity to admit of profitable mining by themselves, and so the only thing to consider is whether or not any zone of the felsitic rock is sufficiently mineralized to be profitably mined.

Fifty feet below this cut and on the side of the bluff a tunnel has been commenced which is in about 8 feet. This working does not show very much workable ore, and again what there is is confined to small irregular seams. The ore extracted from these two workings was carefully hand-sorted so as to make up

a 10½-ton shipment which was shipped to the Anyox smelter. This gave returns of 65 cents in gold and silver to the ton and 5.2 per cent. copper. The rejected material from this hand-sorting has been piled in two dumps, one about 20 tons and the other about 10 tons. These were carefully sampled and returned the following assays:—

Description.	Gold.	Silver.	Copper.
20-ton dump, average	Trace	Trace	1.9
10-ton dump, average	Trace	Trace	1.3

A selected sample of the richest ore on the property assayed: Gold, trace; silver, 0.4 oz.; copper, 15 per cent.

To get to the tunnel a steeply sloping ladder has been built down the side of the bluff. Below the tunnel there is nearly a straight drop to the creek of 135 feet. Ore taken out of the tunnel was hauled up to the bench above on skids. From the ore-sorting shed the ore was lowered on skids for 100 feet down the sloping side-hill, and from this point it was hauled to the railway on a go-devil.

The *Diamond* property has a certain amount of copper ore disseminated through a fissured zone in a felsitic rock. The ore in places is found in narrow irregular cracks, the widest noted being 1 foot wide, but none of these seams are big enough to be individually mined at a profit. The specks of chalcopyrite which are scattered through the felsite, together with a little malachite and azurite (oxidation products), are not in sufficient quantity to make the whole rock-mass into low-grade ore.

The low-grade ore now lying in the two dumps, together with the 10 tons shipped, totals about 40 tons, which has an average assay of 2.5 per cent.; to get this ore something like 500 tons of rock had to be handled.

The possibility for the future of the property is that the whole felsite dyke may carry sufficient copper to make a large low-grade ore-body, but the present development has not yet shown this to be the case. Where there is evidence of mineralization on an extended scale, such as is shown here, it is always worth thorough investigation to see whether or not a large low-grade ore-body may be developed. The present showings are not promising, but somewhere else in the felsitic rock a more highly mineralized zone might be found.

LEGATE CREEK.

Legate creek is a rapid mountain stream which enters the Skeena on the eastern side opposite the town of Pacific, a divisional point on the Grand Trunk Pacific. It rises in a spur of the Coast range and is fourteen miles long. The mountains at the head of the creek are very rugged with sharp, jagged, and abrupt peaks and often have small glaciers on the higher levels. The vegetation is very dense, and while the trees are not particularly large they are quite numerous. The influence of the Coast rains and moisture is plainly shown, particularly in the shrubs and small trees. This heavy growth of small trees and bushes, together with the rough, rugged topography of the country, makes it extremely difficult country to get around in; prospecting there is most arduous, and the wonder is that any men can be found to tackle it. That this locality has been thought promising for prospecting is evident from the fact that during this season about twenty prospectors have been searching the mountains surrounding the headwaters of the creek. In addition to this, one group was bonded by J. J. Price and a force of twelve men put to work. The writer made a trip up the creek to see this latter property, and one other was also examined. At that time the trail up the creek was only a trail in name, as it was not even properly cut out and often followed the bed of the creek. A road-gang, however, was at work and had by then built four miles of a first-class trail good enough for

a sleigh-road. It is believed this trail was finished as far as the forks of the creek, roughly twelve miles. From this trail prospectors can easily make branch trails to their own claims. A ferry was also to be built across the Skeena at Pacific, which would be of great assistance to anybody operating up Legate creek.

The rocks in this district belong to two formations—viz., the Kitsalas series and Coast Range granitic rocks. The Kitsalas series consists of the usual type of highly altered volcanic rocks, a basaltic rock being of most frequent occurrence. The granitic rocks are intrusive into the older volcanics in the form of dykes and bosses.

Price Group. The group of claims bonded by J. J. Price and Aitken consists of the *M. and K.*, *O. and W.*, and some other claims, which were staked by Whitmore & Orr. They are situated at the head of a small creek coming into Legate creek near its head and distant about three miles from the forks. From the creek-level Mr. Price has built a switchback trail up the mountain-side to the claims. A temporary tent camp was put up while this trail was being built, but later it was intended to put in a permanent camp close to the showings of ore.

The main showing of this property—the *M. and K.* group—is a rather peculiar one, as the vein has not as yet been definitely found in place. In a small flat gulch a large quantity of float-ore has been found for a distance of 150 feet up and down the hill. Some surface cuts have been put in and large pieces of the ore dug out, but while the vein or ore-body from which the ore comes has not yet been definitely found, it is possible that by further prospecting it will be found. Mr. Price estimates he has 150 to 200 tons of this float-ore; this seems excessive, but at least there are several car-loads "in sight." The ore itself is peculiar, consisting of a fine-grained mixture of galena and bornite and carrying, it is claimed, good values in silver. Nearly all the float-ore is practically solid sulphide, and some of the pieces are of a size such as to suggest that the vein from which they come is from 2 to 3 feet wide. It may be difficult to market the ore so as to get paid for both copper and lead, but with the copper and silver values alone the ore is good grade ore.

A typical analysis of the solid ore is: Gold, trace; silver, 22.5 oz.; copper, 25.5 per cent.; lead, 32.7 per cent.

Besides this main showing, there are several sheared zones in the altered volcanic rock which show some mineralization with chalcopyrite and iron sulphides. In one of these there is about 2 feet of ore at one place; a sample taken across this assayed: Gold, trace; silver, 6.3 oz.; copper, 9.5 per cent.

None of these showings have had any appreciable work done on them.

The second group bonded by Price & Aitken is the Halliday property. This is said to have a large vein carrying silver-lead minerals and is considered very promising by Mr. Price. This property was not examined as the showings were covered with snow.

Whitmore & Orr have a group of claims near the head of Legate creek and on the eastern side. The only work done is an open-cut on the *Frisco* claim, which shows a mineralized zone in altered basaltic rock. This vein lies almost flat and is from 1 to 2 feet wide. It is mineralized with bornite, chalcopyrite, and copper carbonates. In places the width of clean bornite is from 6 inches to 1 foot. A sample which represents hand-sorted ore, of which there is about 10 tons on the dump, assayed: Gold, trace; silver, 33.5 oz.; copper, 42.2 per cent.

Fiddler Group. This group is situated on Fiddler creek, about four miles and a half from Dorreen Station, on the Grand Trunk Pacific Railway. The property was described in detail by W. M. Brewer in 1914.* Since that report was made only a small amount of further development has been done, chiefly consisting of open-cuts exposing the vein on the surface. It has also been definitely shown that the drift-tunnel, from a point 100 feet from the portal into the face, has followed a stringer into the foot-wall, and that the main vein

* Annual Report of the Minister of Mines, 1914, page 139.

continues in the hanging-wall. The main vein has been broken into at several places beyond where the tunnel leaves it, and there is no doubt a crosscut from the present face of the tunnel into the hanging-wall would pick up the vein.

The property was bonded in July, 1916, to an Edmonton syndicate and work commenced soon after. The plans included building a wagon-road from the property to Doreen Station, the installation of a small hydro-electric plant and compressor, and the development of the property by a lower drift-tunnel. The ore will have to be concentrated, and it is hoped that the development will prove sufficient ore to warrant the erection of a concentrator. During the latter months of 1916 this work was carried on, a force of sixty men being employed for a time. It is believed work will be continued all winter.

The vein is a strong, well-mineralized, bedded fissure, quartz vein averaging about 2½ feet in width and, it is claimed, about $20 to $30 in total values. The sulphides and minerals present are chalcopyrite, galena, pyrite, and zinc-blende, with the first two in greatest abundance. The total sulphides will average from 5 to 10 per cent. of the vein-filling. The main value is in gold occurring in the chalcopyrite. The vein is exposed on the surface for about 800 feet and is nearly everywhere well mineralized.

The following samples were taken, which are across the full width of the vein, but the sections chosen are places where the vein is more highly mineralized than the average. It is not expected or claimed by the owners that average values will much exceed $20 a ton.

Description of Sample.	Gold.	Silver.	Copper.	Lead.
	Oz.	Oz.	Per Cent.	Per Cent.
No. 29. Across 2 feet in surface stripping above tunnel.....	6.54	5.1	1.5	3.5
No. 30. Taken across 25 inches at point 100 feet in the main tunnel.....	1.52	5.2	3.5	8.8
No. 31. Across 2 feet 4 inches in open-cut above tunnel.....	5.78	5.0	1.2	12.5
No. 32. Across 3 feet in open-cut below tunnel.....	0.80	2.0	*Nil.*	4.6

The mixture of sulphides present in this ore will make the concentration of it, so as to save a high percentage of the different minerals, a rather difficult problem. Combined water-concentration and oil-flotation may, however, prove efficacious.

It has been considered advisable to reprint W. M. Brewer's 1914 report on the property, as follows:—

"*The Fiddler Group.*—This group contains three mineral claims—the *Boulder*, *Indicator*, and *Intrusive*, owned by L. C. Knauss. The claims are staked in a line from north-east to south-west, the *Boulder* being the north-east claim of the group, with the other two claims staked in the order referred to, towards the south-west. The north-east end line of the *Boulder* claim is about 2,000 feet south-westerly from the north-west end line of the *Josie* claim of the *Brentford* group, at about the same elevation, but on the opposite side of a tributary of Fiddler creek.

"The ore-body is exposed only on the *Boulder* claim near the discovery post, at an elevation of 2,250 feet, and occurs as a bedded deposit, with its dip comformable to that of bedding-planes of the argillaceous country-rock. The line of strike of the vein is approximately S. 60° E. and the dip is at an angle of 30 degrees towards N. 30° E.

"The ore is galena, iron pyrites, chalcopyrite, and some tetrahedrite in a quartz gangue. The widths of the outcroppings vary from 22 to 36 inches, and the vein is exposed in several open-cuts for a distance of about 800 feet, starting from a point about 200 feet vertically above the creek.

"Five samples were taken of these outcroppings, each one representing an average of the ore-body for the width sampled and at the point designated. The following list shows the values carried by these:—

Location sampled.	Assay Values.		
	Gold.	Silver.	Copper.
	Oz.	Oz.	Per Cent.
Taken across 12 inches at a point 200 feet from discovery post on *Boulder* claim	0.4	2.3	Trace.
Taken across 3 feet at a point about 70 feet from same discovery post	0.25	1.4	Trace.
Taken across 1 foot 10 inches wide at a point 62 feet from same discovery post	2.48	7.6	3.4
Taken across 2 feet wide at a point 49 feet from same discovery post	1.96	8.9	0.8
Taken across 1 foot 10 inches wide at a point 9 feet from discovery post	1.43	5.2	0.6

"Just north from the discovery post on the *Boulder* claim there occurs a wide, intrusive granite dyke which apparently had cut off the ore-body on the dip, but prospecting late in the summer at a point about 400 feet northerly from the discovery post and about 150 feet lower exposed a vein carrying minerals having the same characteristics as those in the vein on the opposite side of the dyke, and also with its line of strike and dip conformable with the strike and dip of that vein, so that it would appear that this last named is the extension of the vein.

"In July last, Martin Welsh, of Spokane, bonded this group of claims and commenced development-work by driving an adit that in October was 140 feet in length. The portal of this adit is located near the discovery post of the *Boulder* claim, immediately south from the granite dyke. The ore-body, which had been left in the roof of the adit, apparently has a width varying from 2 to 4 feet for 60 feet in from the portal, where it becomes narrower, the pinch appearing to have been caused by an intrusive granite dyke, through which, however, the vein appears to maintain continuity for 20 feet to where the granite dyke disappears; there this vein widens to 18 inches, which width it apparently maintains for 30 feet to a well-defined fault which cuts across the adit. Beyond this fault and to the face of the adit, a distance of 30 feet, another fissure is exposed which, while continuous, is only about 4 inches wide. At a few points along the adit for the first 60 feet the ore-body has been broken into above the roof to prove its continuity.

"Samples taken representing averages of the widths sampled at the points designated assayed as follows:—

Location sampled.	Assay Values.	
	Gold.	Silver.
	Oz.	Oz.
Taken across 4 inches at the face of the adit	0.03	0.3
Taken across 10 inches immediately east from fault 110 feet from portal of adit	0.02	0.2
Taken across 18 inches at a point 25 feet east from fault 85 feet from portal of adit	0.32	2.5

"A rough compass survey showed that the adit, beyond a point about 60 feet in from the portal, was not being driven in a course conformable with the line of strike of the vein. From this point the course is slightly changed, so that the roof of the adit is placed so much below the original ore-body as to conceal it completely and make it appear as though cut off. The fissure followed from that point appears to have no connection with the main fissure which outcrops at the surface. The supply of both timber and water for all purposes is plentiful."

SKEENA MOUNTAIN.

Skeena mountain is an isolated mountain mass lying ten miles to the south of Skeena Crossing and on the south side of the Kitsequekla river. It is reached by a trail which is hardly good enough to take pack-horses over. A number of claims have been staked there by B. R. Jones, J. K. Jameson, and J. S. Bagg, but very little development-work has been done.

The long deep canyon which is occupied by the Kitsequekla river divides the Rocher Déboulé Mountain range from another group of mountains to which no particular name has yet been applied. This group of mountains includes the rugged and picturesque group of high peaks known as the Seven Sisters, which lie to the south-east of Miniskinisht, an Indian village on the Grand Trunk Pacific Railway. Skeena mountain is also part of this large group and lies behind the Seven Sisters. These mountains are placed by McConnell as "in the Interior region, although they are not separated from the Coast Range mountains by any marked depression." They merge indefinitely into the long spur of the Coast range which lies to the east of the Kitsumgallum valley, and hence form a connecting phase of mountain-building action between the Coast range and the Interior mountains.

No exact definition of the term "Interior mountains" can be given as yet, as the physiography of this section of British Columbia has never been worked out in any detail. A very considerable amount of work has been done by different officers of the Geological Survey in the territory from Prince Rupert and Telkwa, but this work has not yet been gathered together, correlated, and linked up.

Pole Pick Group.

This group consists of the *Pole Pick*, *Extension*, *Valley View*, *Friendship*, and *Outlet* claims, and is owned by Jones, Jameson, and Jardine. The showings are at an elevation of 5,200 to 5,400 feet, well above timber-line. The main showing is a small vein of arsenical iron from 2 inches to 1 foot wide, exposed in a small open-cut. This vein has an east-and-west strike and dips to the south at 40 degrees. Where seen the vein is in granodiorite rock, but a contact between the granodiorite and quartzites is close by. The contact is irregular and bunches of granodiorite are exposed breaking through the quartzites in many places. The vein may not continue to lie in granodiorite throughout its whole length, but may pass into quartzite or lie in the contact between the two rocks.

The main sulphide mineral present is arsenopyrite, but a little pyrite and chalcopyrite were also seen. A sample across 10 inches was taken at the best-looking place in the vein and assayed, with the following results: Gold, 0.2 oz.; silver, 9 oz.; copper, 4.4 per cent. Another selected sample of nearly solid arsenopyrite returned: Gold, 0.78 oz.; silver, 0.6 oz.; copper, *nil*. This latter assay is interesting in that it shows that the arsenical iron carries very fair gold values. It is, of course, evident that such a small vein with comparatively low values is not of much importance other than as an indicator. The vein is as yet undeveloped, but somewhere it might contain an ore-shoot of commercial value, or it can be taken as an indication that this locality has been to some extent mineralized, and other more promising veins may be found. The writer would advise the owners to systematically prospect the surface of their claims rather than to undertake any development of this small vein.

On the *Extension* claim there is a large "blow-out" of quartz which does not appear to be in the form of a vein. It may not be true quartz, although it appears to be so; the exact nature of its occurrence was not determined by the writer. It shows some very small streaks of arsenical iron and in places a little fluorite. It is probable that this occurrence is in the nature of an extremely acid dyke connected with the intrusions of granitoid rock. Samples taken and assayed show that this "quartz" carries no appreciable percentages of the precious metals.

Helen Group. This group, consisting of the *Helen*, *North Star No. 1*, and *North Star No. 2 claims*, lies a mile or more to the north-west of the other claims. The showing is on the *North Star No. 1* claim and at an elevation of 5,550 feet; Jones & Jameson are again the owners.

There are two nearly parallel veins striking east and west (mag.) and dipping at 60 to 75 degrees to the south (out of the hill), on which but little work has been done. Apparently these veins also occur in granodiorite rock and are only a short distance apart. They both represent fissured zones in the granodiorite rock in which the crushed rock has been in part replaced by minerals. Both veins are considerably leached out and oxidized on the surface; the outcrops consist of soft gangue rock and limonite and small amounts of pyrite and chalcopyrite. The upper vein has a width of 3 to 4 feet and the lower one about 2 feet, but neither are exposed for any great distance.

A sample of sulphide mineral, which had to be carefully selected as there is very little of it, assayed: Gold, trace; silver, 15.6 oz.; copper, 14.5 per cent. The showings warrant a little further exploration to determine the size and character of these veins.

Prospecting in this vicinity was being carried out by J. S. Bagg, but at the time of visiting the camp in July he had made no important discoveries.

HAZELTON.

The town of Hazelton and its younger sister, New Hazelton, are in about the same condition as they were in 1914. During the summer of 1916 a mild form of a mining boom was in evidence, but it was of a healthy kind and not the "wild-cat" type.

Several mining camps are tributary to either or both of these towns. These camps are Rocher Déboulé, Glen, Nine-mile, and Four-mile mountains. As yet, however, none of these camps has reached a sufficiently productive stage, which would entail the employment of large numbers of men, to provide support for a good-sized town. With the growth of mining in the district, however, and the increase in agricultural production which will gradually take place, both towns expect to prosper and hope to gradually increase in size.

The greatest activity in the district was on Rocher Déboulé mountain, where a number of properties were acquired under options during the year, and on several of these work was commenced.

ROCHER DEBOULE CAMP.

The name "Rocher Déboulé camp" may be restricted to mean that piece of country surrounding the head of Juniper creek and its small tributary, Balsam creek. It includes the *Rocher Déboulé* mine, *Great Ohio*, *Highland Boy*, *Delta*, and *Red Rose* group, besides many less-well-known claims. The *Hazelton View* group and other claims controlled by the New Hazelton Gold-Cobalt Company are situated a short distance over the ridge of Rocher Déboulé mountain from the mine of the same name, but they are reached by means of a trail starting at Carnaby, on the Skeena River side of the mountain.

Rocher Deboule. This mine still continues to hold its place as the most important mine in the Omineca Mining Division. It was worked steadily during 1916, and while a considerable tonnage of ore was shipped, at the same time development-work was pushed ahead. The lease under which the Montana Continental Development Company commenced to work the mine in August, 1913, ran out in February, 1916, and since that time the operation has been in the hands of the original company—the Rocher Déboulé Mining Company. During the tenure of its lease the Montana Company developed the mine from a prospect; equipped it with a hydro-electric plant, compressor, surface and aerial tramways, and much incidental machinery, ore-bins, buildings, etc.; and shipped ore to the value of about $700,000.

When the location of the property is considered, its high elevation (4,000 to 6,000 feet) with workings above timber-line, the long severe winter weather to be contended with, and the usual difficulties of opening up a mine in a new camp and a new country, this record, attained in thirty months, stands as a testimonial to the ability, energy, hard work, and initiative of the manager, D. J. Williams.

The change of control from the leasing company back to the owning company is more apparent than real, as the leasing company was largely made up of the majority stockholders of the owning company. No change in management was made, and the only change in policy is that more attention is now being paid to development.

As might be expected, the leasing company, after developing to a certain point, then turned to ore-extraction almost exclusively. The result was that at the end of the lease the mine was practically exhausted from the 300-foot level to the surface, and extensive development was the first requirement for the mine.

In his 1914 report on the Omineca Mining Division the writer described the *Rocher Déboulé* mine in some detail, so that no repetition of the early development will be given here.* At that time the 300-foot crosscut tunnel was being driven and was in 300 feet. This crosscut struck the vein at a point 670 feet from the portal, and an additional 70 feet was driven on into the hanging-wall in order to make sure that the main vein had been encountered.

The vein was not mineralized to any extent where it was first struck, but drifting to the east on the vein soon revealed a good pay-shoot of ore. This drift was run for some distance to the east and four distinct ore-shoots were found, the first being 80 feet long and the second 160 feet; the lengths of the other two were not noted, but they were in the neighbourhood of 100 feet. These first two shoots were stoped out right to the surface and the others nearly to the surface. The average width of ore is not known to the writer, but it fluctuated from 1 to 8 feet. The sulphide minerals in these pay-shoots are chalcopyrite and pyrite, and very occasionally a little tetrahedrite (grey-copper). Along the hanging-wall of the vein there is, as a rule, from a few inches to 1 foot of crushed broken granite which in mining cannot be kept from falling into the ore, and therefore lowers the grade of the ore. This, of course, only occurs where the pay-shoot is developed, against the hanging-wall. The pay-shoot may be found on either wall, and sometimes it splits into a shoot on each wall, separated by a band of waste rock of varying width. The ore-shoots, as a rule, cut off abruptly and low-grade ore carrying disseminated chalcopyrite is not of frequent occurrence. The values are mainly in copper, together with small gold and silver values. The production for 1915 was 17,000 tons, averaging about $1.65 in gold and silver to the ton and 8 per cent. copper. When it is considered that, mining in this way and shipping without hand-sorting, a large amount of waste rock necessarily is included in the ore, it is evident that the clean shoots of ore carry a high percentage of chalcopyrite. It is estimated that the production for 1916 will have been about 16,800 tons, containing 1,200 oz. gold, 16,700 oz. silver, and 1,619,145 lb. copper (recovered copper).

When the Montana Company's lease expired in February the mine was in this condition, and a comprehensive plan of development was immediately commenced by Manager Williams. In order to keep up ore production underhand stoping was continued from the 300-foot level downwards, this work being confined to the most easterly ore-shoot. In order to develop the ore-shoots to a greater depth a winze was sunk from the 300-foot level. This was sunk at a point 500 feet from the crosscut tunnel and between the second and third ore-shoots; in this way the winze was about in the centre of the known ore areas. A crosscut from the drift was first driven into the foot-wall for a distance of 75 feet; a station was then cut out for hoist, ore-bins, etc., and the winze proper is 35 feet from the main drift. It is 200 feet deep on a 60-degree pitch. From the bottom of the winze a crosscut 62 feet in length was driven to intersect the vein. Drifting was commenced on the vein in

* Annual Report of the Minister of Mines, 1914, page 185.

both directions, and on July 10th (time of visiting the property) the east drift was in 234 feet and the west drift 254 feet. The shaft (winze) is fitted up in good shape with a compressed-air hoist, automatic skip, made at the mine, ore-bins, etc., and is capable of handling a large tonnage of ore and waste.

The drifting on the 500-foot level from the bottom of the winze had failed to reveal any large ore-shoots up to the time of examining the property, but later information is that good ore has been found on this level. There is little doubt but that the shoots of ore found on the 300-foot level will have a downward continuation somewhere; by this it is meant that, though these shoots may end abruptly, other shoots will be found not far distant.

The ore when taken out is hoisted up the winze and run out the 300-foot crosscut tunnel and dumped into ore-bins. From these bins it is taken in a surface tramway about 3,000 feet to ore-bins situated at the top of the mountain and facing the Carnaby side. From here an aerial tramway in two independently operated sections takes the ore down to ore-bins at Tramville, the company's station on the Grand Trunk Pacific Railway. Tramville is one mile and an eighth from Carnaby, the official Grand Trunk Pacific station. As there is nothing at Carnaby, the Rocher Déboulé Company has made many efforts to get the railway company to recognize Tramville as a station, but without avail. The case has been before the Railway Commission once or twice, and this Board has ordered the railway company to make some concessions to the Rocher Déboulé Company. There is no doubt in the mind of any impartial observer that the station should be where the business is—viz., at Tramville—and not at Carnaby.

The 300-foot level tunnel from which the main vein is worked is situated about 900 feet above Juniper creek. The compressor, camp buildings, etc., are all situated down in the Juniper Creek valley (gulch). The mine is therefore worked from the Juniper Creek side of the mountain, but owing to the configuration of Rocher Déboulé mountain it was found possible to run the ore around to a low part of the summit of the mountain and down by tramway to the railway on the Skeena River side of Rocher Déboulé mountain. This topographic feature of the mountain was a fortunate thing which was fully taken advantage of, as it would have been a good deal more difficult to have taken the ore down to the railway via Juniper creek.

Between Juniper creek and the main vein there are two other veins roughly parallel to the upper one. The work done on them was described in the 1914 report, and since then no further development has been done. In order to prospect all three veins at depth a crosscut tunnel has been started at a point a short distance above the compressor. It is about 800 feet below the 300-foot level tunnel and will have to be driven half a mile or more to intersect the upper vein. The lowest vein on the hill should be encountered in a distance of 1,100 to 1,200 feet. From the surface showings and small amount of work done on the two lower veins it seems reasonable to suppose that development may reveal some good ore-shoots. Eventually, if all three veins develop as expected, some sort of concentration scheme will have to be devised. This is particularly true for the two lower veins, as the surface indications are that if ore-shoots are found in them they will consist in part at least of disseminated ore which would require concentration before shipping.

A short description of the probable origin of the ore-bodies was given in the 1914 report, and the writer sees no reason to change the general statement then made, but a more full account can now be given. As there are so many veins in the Rocher Déboulé mountains that are similar to the *Rocher Déboulé* mine veins, a thorough study of the latter would no doubt be of considerable economic value to the district. The writer regrets that he was unable to spend more than one day on the property during last season, but as much as possible was ascertained in that time.

In going in the 300-foot crosscut tunnel, which is 700 feet long, a good section of the granodiorite formation, in which the veins occur, can be seen. In places the

rock is very acid, consisting almost entirely of quartz and feldspar, with little or no hornblende present; another phase consists of zones or bands of dark material which is nearly altogether hornblende. These extreme phases pass gradually and sometimes sharply into normal granodiorite and rock which is normal diorite or quartz diorite. The basic and acidic zones do not represent true intrusive dykes, although in places they look very much like this, but were probably formed by the segregation of bands of mineral during the cooling stages of the granodiorite magma.

The main vein has been said to be a replacement ore-body formed in a hornblendic dyke; but the writer considers that the postulated "hornblendic dyke" is one of the segregation bands of hornblende and not a true dyke. The vein follows this hornblendic band fairly closely, but in some parts it is in normal granodiorite.

It would appear as if the fractured zone, produced by differential shearing, in which the ore has been formed had to some extent followed a hornblendic band, or, in other words, this basic zone of rock formed a line of weakness, so that when differential stresses were set up in the granodiorite, fracturing and shearing took place in this zone. This fractured zone roughly follows the hornblendic rock, but not entirely. There would appear to have been two main fractures varying from 1 to 12 feet apart, with a fractured zone between which varies from gouge-matter to normal granodiorite.

The fractures, seams, and possibly open fissures in this sheared zone allowed the circulation of mineral-laden solutions which formed the ore-body. The actions which took place were a partial replacement of the rock-matter of the sheared zone by mineral sulphide and an alteration of the mineralogical composition of the rock-matter—a metasomatic process. In places there may have been definite open fissures which were filled with sulphides and quartz which had precipitated and crystalled out from the mineral-bearing solutions. As has been before noted, the ore occurs in very definite ore-shoots, and it may be that these shoots were formed in places where the rock was very thoroughly fractured and brecciated, or possibly these ore-shoots were formed in zones where there were many small open fissures which allowed a thorough circulation of the ore-bearing solutions. When the ore-shoots cut off, as they do often very abruptly, the vein consists for the most part of nearly normal granodiorite with seams on either wall, with but slight evidence of fracturing in the vein-matter. All stages between normal granodiorite, partially altered and mineralized granitic rock to solid bands of chalcopyrite lying between the main walls of the vein, can be seen in different parts of the mine.

The hanging-wall is nearly always well defined with a considerable development of kaolinized gouge-matter and crushed granodiorite against the wall, but the foot-wall is often very indefinite. Ore-shoots more often follow the hanging-wall than the foot, but in places there is a shoot on both walls separated by a few feet of barren, partially silicified and altered granodiorite.

The vein is not quite a simple vein—that is, a definite fracture-zone confined between two walls of varying width—but in places it splits up or sends off subsidiary branching fractures distinct from the main fracture which continues. Apparently the hanging-wall represents the direction of the main fracturing force, but the foot-wall, while approximately parallel to the hanging-wall, is less definite, and in places consists of several fractures in different directions.

Highland Boy Group.

This group was described by the writer in his 1914 report.* That report, although brief, covers the main facts, and but little further need be said here. In addition to the veins described in the earlier report, there is another one outcropping on the *Iowa* side of the mountain, which may prove to be a continuation of one of the others. It has not been developed to any extent.

No work has been done on the property during the last two years. A Spokane syndicate secured an option on the group about the end of 1914, but did not commence work immediately. Later a dispute arose as to the terms of the agreement

* Annual Report of the Minister of Mines, 1914, page 189.

and the case was taken to the Courts. At the time of writing this (December, 1916) no word has been received as to the settlement of the dispute. It is probable, though, that before long arrangements will be made which will permit of the development and thorough testing of the property.

Great Ohio.

This property, owned by Jennings, Trimble, *et al.*, was described in the 1914 report by the writer and was not visited in 1916. The main working two years ago was a drift-tunnel about 350 feet long which followed a small stringer. The work during the last two years has been to explore, by means of a crosscut from this drift, the main vein which outcrops on the surface and which is roughly parallel in strike with the stringer in the drift-tunnel.

The crosscut from the end of the drift-tunnel was run 189 feet, where a small vein was encountered, and this was drifted on for 127 feet. As it was evident that this small vein was not the main vein outcropping on the surface, the crosscut was continued for some distance until the main vein was finally struck. This vein was then drifted on in an easterly direction (into the mountain) for a distance of 260 feet, and drifting is being continued. As yet no commercial-sized ore-shoot has been found, but small lenses and bunches of good ore have been run into from time to time, sufficient to encourage the owners to keep on. From the surface showings it would seem probable that somewhere in the vein commercial ore-shoots might be found.

Red Rose Group.

This group of claims was also examined and reported on by the writer in the 1914 report, where details of the first work done are given. In the fall of 1914 the *Red Rose* group was acquired under option by a development syndicate, which commenced operations at once with T. J. Vaughan-Rhys in charge. Since that time changes have occurred in ownership, but the exact details are not known to the writer. The property is now under the control of the Skeena Development Company, but it is understood that it is still only held by option or lease and bond, subject to further money payments to Peterson & Ek, the original owners who staked the claims.

The prospect-tunnel described in the previous report as being 30 feet long has been extended to a length of 125 feet. Nearly 500 feet below this and at some distance to the south a crosscut tunnel was started to tap the vein. This was driven 450 feet without striking anything; it is entirely in quartzite.

At the time of visiting the property in 1916 (July 11th) John McIsaac was in charge, and was at work himself together with one man. A larger force was expected to be employed in a short time.

The formation at this point consists mainly of quartzites and argillites of the *Hazelton formation*, which are intruded by small bosses and dykes of diorite and granodiorite belonging to the granitic batholithic rocks known as the Bulkley eruptives.

The main showing on the property is a vein which occurs in places in the contact between the sediments and the granodiorite, and in other places is entirely within one or other of the rocks. In the 1914 report it was stated that the vein as disclosed in the prospect-tunnel lay in granodiorite, but it is now apparent that the tunnel swings away from the granitic rocks and is entirely in quartzite. The whole rock of the tunnel is much decomposed and is soft, friable, and of a reddish colour from the presence throughout of iron oxide. This material carries some gold values, but is evidently too much leached out to contain much copper mineral. Near the mouth of the tunnel and on the surface there is a good development of copper minerals on the granodiorite foot-wall, but the tunnel by swinging away from the foot-wall affords no information about this ore. A crosscut from the face of the tunnel back to the foot-wall might be useful development-work.

The vein was then ground-sluiced and exposed down the hill for 200 feet. Here it shows as a band of iron oxide, 2 feet wide, and in contact with dioritic rock. Fifty feet below and nearly on the line of continuation of the vein a tunnel was

started and was in 20 feet in slide-rock. This was expected to strike the vein in a short distance and then would be continued as a drift-tunnel. The crosscut tunnel, which was driven 450 feet, is 250 feet below this present working and would strike the vein 150 feet farther to the east. Also if the vein was vertical, or nearly so, the crosscut would have to be 200 or 300 feet longer to strike the vein. It will be seen, then, that this crosscut was a "long shot," and hence cannot be considered as being very definite work in proving or disproving the property.

Another tunnel, known as the intermediate and 40 feet long, lies just to the north of the present tunnel now being driven. It shows a contact between quartzite and granodiorite and slight mineralization. The extreme irregularity of the different contacts between the quartzite and granodiorite make it difficult to follow them on the surface, but there seems little doubt that mineralization is most pronounced near these contacts. The word "vein" perhaps inadequately describes the ore-body on this property, as it is possibly not a true vein, but is more of the nature of a contact ore-body.

It must be admitted that the actual amount of ore disclosed by the money spent in development is disappointing, but it is also certain that the property is not yet thoroughly tested.

New Hazelton Gold-Cobalt Mines, Ltd.

The claims owned by this company comprise the *Hazelton View* group and the *Victoria* group (eight claims in all), situated on the west side of Rocher Déboulé mountain, and at an elevation of from 4,000 to 6,300 feet. The property is reached by means of the old *Rocher Déboulé* mine trail from Carnaby, on the Grand Trunk Pacific Railway. This trail is followed for some distance up the mountain to an elevation of 4,000 feet, where a branch trail half a mile long is taken to the camp of the Gold-Cobalt Company, this being at an elevation of 4,150 feet. At the time the property was examined—July 13th—the company had not commenced development-work on the property, but during the last month had built three good cabins, and was just finishing a trail up the mountain-side to a point on the vein where it was intended that the driving of a drift-tunnel would be immediately commenced. Eight men were employed under the superintendence of Duke Harris.

There are two veins on the property, but only one is of sufficient importance to be considered at the present time. The formation of the mountain in this section is mainly granodiorite, but some areas of the Hazelton quartzite also occur, generally some distance below the top of the ridge. The vein which is to be worked lies entirely within the granodiorite. Attempts have been made by means of surface cuts, which, however, are not conclusive, to trace this vein down the hill towards the camp and into a quartzite area, but these have not been successful. The vein is a well-defined fissure, varying from 1 to 3 feet wide, and striking N. 50° E., with a north-westerly dip of 60 degrees. The lowest point at which the vein is exposed is in an 18-foot tunnel at an elevation of 5,400 feet; from this working the vein can be traced at intervals to the top of the ridge at an elevation of 6,300 feet (this ridge is a long north-westerly spur running out from the main Rocher Déboulé Mountain mass). Beyond the top of the ridge—i.e., down the other side—the vein has been traced for a short distance. The mountain-side up which the vein is exposed has a slope of approximately 45 degrees, and therefore a drift-tunnel would gain a foot in depth for each foot driven. It was proposed to drive ahead on the present prospect-tunnel; it would therefore require a 900-foot tunnel to get under the top of the ridge and would give nearly a corresponding depth.

The vein-filling consists of altered granite, hornblende, chloritic material, and some quartz, and the ore-minerals are arsenical iron and pyrrhotite and occasional flakes of molybdenite. Cobalt bloom is of frequent occurrence, but no cobalt sulphide minerals were identified; it is possible that the cobalt occurs in the arsenical iron, partially replacing the iron. As is customary in this district, the vein at the surface, in most places, is considerably oxidized and leached out, and consists of rusty-coloured iron oxide and rotten rock-matter.

In the tunnel the vein is about 18 inches wide and shows on the hanging-wall 4 to 6 inches of sulphide mineral, while the balance is mainly hornblende. Sample No. 18 was taken across 8 inches of the most mineralized portion of the vein in this working.

From this tunnel going on up the hill the vein is for the most part covered with slide-rock and snow to an elevation of 6,250 feet, but Mr. Harris says that he has uncovered the vein at intervals along this distance. Sufficient evidence in the shape of iron oxide and float could be seen to make it certain that the vein is continuous up the mountain-side. At elevation 6,250 feet a prospect-cut has been made which shows about 2 feet of oxidized vein-matter which is said to carry good gold values. Sample No. 16 was taken across 20 inches at this point.

Fifty feet vertically above and right on the top of the ridge a small cut shows the vein to be dipping at an angle of 45 degrees and having a width of 20 to 24 inches; here the vein is well mineralized with arsenical iron and is said to assay well in gold and cobalt. Cobalt bloom occurs here plentifully along the seams of the rotten rock-matter, but not on the sulphide minerals. Sample No. 15 was taken in this cut across 2 feet.

Sample No. 13 is high-grade selected ore from the vein at the top of the ridge. Sample No. 14 is rock-matter showing cobalt bloom which will show whether any gold occurs in this material or only with the sulphides.

On the other side of the ridge the vein is exposed in an open-cut 6 feet deep. The bottom of this cut had water in it, but a sample (No. 12) was taken across 2 feet 6 inches (the full width of the vein) on the side of the cut. Six inches of the vein at this point showed sulphides; the balance is decomposed and leached vein-matter.

The development-work described above was all that had been done on the property at the time of examination, so that it was then an undeveloped prospect. There is very little doubt but that the vein will be found to continue at depth and to maintain an average size of at least 2 feet.

The following list gives the assays of samples taken on the property; the sample numbers correspond to numbers previously mentioned in the text:—

Description of Sample.	Gold.	Silver.	Copper.
	Oz.	Oz.	Per Cent.
No. 12. Across 2 feet 6 inches in cut over the ridge, 6 inches sulphides and 2 feet rock-matter with some limonite	0.65	0 2	1.0
No. 13. Selected high-grade arsenical iron, top of ridge	3.6	0.4	3.4
No. 14. Selected material showing cobalt bloom, mostly decomposed hornblendic material	0.44	0.1	0.9
No. 15. Across 2 feet of good ore, full width of vein, top of ridge	4.0	0.2	3.0
No. 16. Across 20 inches decomposed rock-matter in cut at elevation 6,250 feet	0.32	Trace.	0.7
No. 17. Across 8 inches of pay-streak in tunnel, should be good ore	0.82	0.3	1.4

These assays show that the vein carries gold values everywhere it was sampled. It is evident that most of the gold is carried in the arsenical iron and but little in the gangue-filling of the vein. Where the vein-filling carries considerable limonite, resulting from the oxidation of iron sulphide, values are better than in the straight gangue rock.

The assay results show that this prospect has some ore carrying good gold values, and the only question to be solved is the amount of ore—i.e., whether or not there are commercial-sized ore-shoots. With judicious management this property may develop into a productive mine.

Cap Group. This group was described by the writer in his 1914 report.* The property is now owned by Denis Comeau, Magnus Johnson, and Gus Norberg, and consists of the *Cap, Bolton, Beatty,* and *Hermes claims, none of which is Crown-granted. The workings consist of surface*

* Annual Report of the Minister of Mines, 1914, page 200.

cuts, a 20-foot shaft, and a tunnel. Of these, only the tunnel is new work in the last two years; the other workings were described in the previously mentioned report, to which the reader is referred.

The tunnel was commenced at a point 40 feet below the collar of the shaft, and is a crosscut for 81 feet, at which point the vein was struck. A drift was then run 20 feet to the north-east, where a flat fault cuts off the vein. By drifting up the hill the continuation of the vein would probably be found. A drift was then run to the south-west for 27 feet, which brings it under the 20-foot shaft. At the time of visiting the property (July 7th) a raise was being put up from this drift to connect with the bottom of the shaft.

Throughout this working the vein consists for the most part of gangue-matter with but little ore in it, except where the south-west drift approaches, and is under the shaft. This part of the tunnel is in a small shoot of ore which is also shown at the surface and in the shaft. In the raise this shoot of ore has a width of 30 inches, and an average sample across this width assayed: Gold, trace; silver, 3.2 oz.; copper 3.7 per cent. About 20 tons of the best ore taken out in drifting on this ore-shoot has been saved and piled on the dump. An average sample of this assayed: Gold, 0.03 oz.; silver, 10 oz.; copper 8 per cent. A piece of solid arsenical iron was assayed to see if it carried higher values in gold than the other sulphides; this returned: Gold, 0.14 oz.; silver, 10.5 oz.

The contour of the ground is such that if the drift to the south-west were continued on the vein it would soon come out at the surface. It is evident, therefore, that this shoot of ore has not any great size above the present working-tunnel. It is, of course, quite possible that this shoot of ore extends down, and if so could be reached by a lower tunnel.

From the experience in a similar kind of vein on the *Rocher Déboulé* mine it is evident that the ore is confined to well-defined ore-shoots, and that the intervening spaces on the vein are practically barren vein-filling. Reasoning from this experience, it is likely that, while the north-east drift on the *Cap* property is in a barren zone of the vein, a further continuation of drifting might bring the drift into another ore-shoot. The fault at the end of the drift should present no serious obstacle, as it is very likely that by following the fault-plane up the hill a short distance the vein would be found again.

Daley West Group.

This group is situated two miles and a half from New Hazelton, on the northern slope of Rocher Déboulé mountain. At a point half a mile from New Hazelton a wagon-road to the property leaves the main road and extends to the camp and compressor-site. From the compressor-site a trail leads up a rock-slide to the workings some 300 feet above.

The Spokane Rocher Déboulé Mining and Copper Company secured this group a year ago and commenced development-work this summer (1916). Work was continued for a short time, but stopped in August, and it is not believed anything has since been done. The writer examined the property on July 6th, at which time a tunnel was being driven and the compressor being installed.

The compressor is a 3-drill machine and was to be driven by a 25-horse-power engine, using distillate as fuel; the machinery had been hauled in and concrete beds were being put down on which to place the engine and compressor. A frame building was being erected over the compressor-site. The blacksmith-shop is situated at the mouth of the tunnel. No camp buildings had been erected, the men at work walking to the mine from New Hazelton. Wm. Brady was in charge of the work.

Rocher Déboulé mountain consists of a core of granodiorite, intrusive into the older rocks of the Hazelton formation. On the northern side this granodiorite is the most frequent rock seen, and on the *Daley West* group it is the only rock exposed. Cutting this granodiorite in a direction N. 12° W. (mag.) is a fairly well-defined vein. It is from 1 to 4 feet wide, with an average of about 3 feet, and strikes up and down the hill, thus making it possible to develop by means of drift-tunnels.

This vein is of the replacement sheared-zone fissure type and has for the most part a filling of altered granodiorite. The vein represents a fissured zone in the granodiorite along and up which flowed alkaline solutions carrying silica and some metallic sulphides; by metasomatic processes the original granodiorite of the fissured zones was in places removed and replaced by silicia and metallic sulphides, while the whole vein-filling was considerably silicified. Occasionally places in the vein show true quartz with some metallic minerals.

The principal metallic mineral found in the vein is arensopyrite, which has a more silvery colour than usual. Other minerals found are pyrite, pyrrhotite, and a little chalcopyrite.

Description of Workings.—The workings consist of a few surface cuts and a tunnel which at the time of examination was 65 feet long. The tunnel is the lowest working down the hill. A shallow cut 150 feet above the tunnel shows the vein to carry at this point 1 foot of nearly solid arsenical iron. Two more cuts about 75 feet above the tunnel show the vein to carry some pyrite and a little chalcopyrite. The surface outcroppings of the vein are as a rule decomposed and rusty-coloured from the action of surface waters and oxidation of the iron sulphides present.

The tunnel goes in as a half-crosscut for 20 feet to where the vein was encountered; from this point the tunnel is a drift on the vein. Throughout this working the vein is slightly impregnated with sulphides, the best place being where the vein was first struck, where there is a width of 1 foot of nearly solid arsenopyrite. At the face the vein was nearly the width of the tunnel and consists of a band of quartz with a little mineral on the hanging-wall, next a thin talcose seam, then a band of nearly unaltered granodiorite in the centre, and a band of slightly mineralized and silicified granitic rock on the foot-wall.

About a ton of ore has been saved from the material extracted in driving this tunnel; this ore is mainly arsenical iron. An average sample of it was taken and assayed, with the following results: Gold, 0.1 oz.; silver, 1.5 oz.; copper, 0.9 per cent.

A sample of solid arsenical iron was also taken and tested for nickel and cobalt, with the following results: Gold, 0.1 oz.; silver, 1.7 oz.; cobalt, *nil;* nickel, *nil.*

These results are disappointing, as it was confidently expected that the arsenical iron would carry good gold values. With a well-defined vein such as this is and showing some evidences of mineralization, it is, however, quite possible that at some places a good ore-shoot might be found. Most of the veins on Rocher Déboulé mountain show good copper ore in places, and it is possible that this vein if further developed would also do so.

MUD CREEK.

Mud Creek rises in the Rocher Déboulé mountains, in the group of high peaks around the head of Juniper creek, and flowing almost easterly, or in a direction nearly opposite to that of Juniper creek, joins the Bulkley river about eight miles above New Hazelton. A number of claims have been staked at the head of this creek and the surrounding territory. The more important of these claims were examined by the writer's assistant, D. A. MacKinnon, and the following notes are based on his observations.

The claims are reached by a wagon-road for a part of the distance and then a trail, a total distance of about twelve miles. On the *Black Prince* group there is a cabin camp at an elevation of 4,050 feet, while all the showings are at higher elevations. The cabin is approximately at timber-line and the showings all above.

The main formation exposed is the typical granodiorite of the Rocher Déboulé mountains, and cutting this are a number of veins which are probably of the sheared-zone type, but which in places are apparently true fissure-filled veins.

Black Prince Group.

This group, consisting of the *Black Prince, Black Diamond, Lake View, Annex, Trumwater, Chickamon,* and *Kelting* claims, and owned by Barney Halloran, R. Hadden, and William Thompson, is situated in the Mud Creek basin. On the *Black Prince*

claim, at an elevation of 4,200 feet, a tunnel 125 feet long has been driven on a vein varying from 3 to 10 inches in width; this vein strikes S. 58° E. and dips at 50 degrees to the south-west. A sample taken from the high-grade dump at this tunnel assayed: Gold, 0.04 oz.; silver, 0.9 oz.; copper, 6.4 per cent.

At an elevation of 4,300 feet an open-cut has been made on a vein which strikes S. 73° E. and dips 60 degrees to the south-west. This cut is about 30 feet to the west of the vein on which the tunnel has been driven. The vein here is about 4 feet wide, slightly mineralized throughout, and with a 10-inch pay-streak on the foot-wall. A sample taken across this 10-inch pay-streak assayed: Gold, 0.14 oz.; silver, 2 oz.; copper, 11.2 per cent.

Stripping the vein on the surface should show whether the tunnel and open-cut are on separate veins or on the same vein, faulted. The tunnel is driven along a mineralized stringer for about 90 feet, and, from here on, the vein is practically barren. At this point, 90 feet from the portal, a well-mineralized stringer 4 to 6 inches wide joins the vein on the hanging-wall. This may be a cross-stringer between the two veins or it may be an indication that the faulting of the vein takes place here. The tunnel would have to be driven about 50 feet farther and then crosscut to the west about 30 feet to get under the open-cut.

The veins are in granite and have a quartz gangue where well mineralized; but poorly mineralized portions of the vein have a slightly decomposed granite-filling.

Black Diamond.

The workings on this claim are about 1,500 feet south-westerly from the tunnel on the *Black Prince* claim, and are at elevations of from 4,600 to 4,700 feet. The vein is traced about 600 feet by means of open-cuts and stripping, and has a strike of S. 65° E. and dips to the south-west at 65 degrees.

At an elevation of 4,600 feet an open-cut shows the vein to be about 8 feet wide, but mineralized only in stringers; four stringers are from 3 to 11 inches wide. The filling of these stringers is badly decomposed and leached out, probably originally of granitic character; a sample of this vein-filling was analysed for tungsten, with the following results: Gold, trace; silver, 0.6 oz.; tungstic oxide, 4 per cent. Some wolframite is found in these stringers in small lumps scattered throughout the vein-matter.

At an elevation of 4,650 feet the stringers come together to form one vein about 2½ feet wide. An open-cut shows the vein here also to be highly decomposed and leached out. A sample taken across 2½ feet in this open cut assayed: Gold, trace; silver, 0.6 oz.; tungstic oxide, 1.1 per cent.

At an elevation of 4,670 feet a small open-cut shows 2½ feet of badly leached-out vein-matter. A sample of this assayed:- Gold, trace; silver, 6.4 oz.; tungstic oxide, trace.

The vein is in granite, having a quartz gangue where mineralized, and is quite strong whenever exposed, and scattered lumps of wolframite are found in the open-cuts that have been made.

The percentages of tungstic oxide as shown by two of these assays are encouraging, and further prospecting of the showings should be carried out. The samples were taken of decomposed granitic vein-filling, in which no tungsten-bearing mineral was apparent to the eye. It has been determined, though, that the tungsten mineral is wolframite occurring in minute particles in the gangue rock. Occasional pieces of wolframite are found in places in the vein, weighing up to an ounce or two.

The mineral wolframite is a tungstate of iron and manganese, with the formula $(Fe, Mn)WO_4$, in which the iron is generally present in greater quantity than the manganese. Wolframite is a dark brownish-black to reddish-black mineral, with a resinous to sub-metallic lustre, and a hardness of 5-5.5 (scratchable with a knife), while the specific gravity is from 7.2 to 7.5 (about three times as heavy as quartz, which is 2.65). The streak is usually black to dark reddish-brown, but sometimes lighter to a greenish-grey. The mineral is usually opaque, but sometimes translucent,

and is sometimes weakly magnetic. The fracture is uneven, but generally there is one good cleavage and the mineral is brittle. The mineral contains from 75 to 76 per cent. tungstic oxide—WO_3. It is easily fusible before the blow-pipe and becomes magnetic on fusing.

The market requirements are such that a tungsten ore to be saleable must contain about 60 per cent. tungstic oxide (WO_3). This means that the ore must contain at least 80 per cent. wolframite, so that but little gangue rock is allowed.

It follows, therefore, that nearly all tungsten-bearing ore must be concentrated to get rid of the gangue before it is marketable. The price paid for tungsten ore, of a grade of 60 per cent. WO_3 and upwards, is about $15 to $20 a unit of WO_3. A ton of ore containing 60 per cent. WO_3 would therefore be worth from $900 to $1,200. The price has risen considerably in the last two years owing to the great demand for tungsten in the manufacture of special steels for war purposes. The price has fluctuated considerably during the last year and is still subject to sudden changes.

It is evident from the price paid for tungsten-bearing ore that material carrying even 1 per cent. tungstic oxide, if found in sufficient quantity, constitutes good ore, but, of course, would require concentration before being saleable.

The decomposed granitic vein-filling carrying wolframite at Mud creek would be easy to concentrate, but it is quite probable that where the vein is not oxidized it will be found to contain some sulphides, and the concentration to save the wolframite would then be more difficult.

A few other claims near the head of Porphyry creek were looked at, but they are as yet unimportant prospects.

FOUR-MILE MOUNTAIN.

Some claims on Four-mile mountain were also examined by D. A. MacKinnon, and from his observations the following notes are written:—

Centre Star. The principal group is the *Centre Star*, owned by J. S. Martin and partners. Several veins are exposed on the hill varying in width from 6 inches to 4 feet; they are filled up with a quartz gangue, carrying a little galena and zinc-blende and in places a little molybdenite. Values are principally in silver. The formation consists of sedimentary beds of the Hazelton formation intruded by acidic granitic dykes.

The upper vein, which strikes N. 70° W. and dips at 35 degrees to the north, is traced on the surface for 140 feet by means of open-cuts. This vein is about 3 feet wide, but only carries some small stringers of ore; it is at an elevation of 1,300 feet. The lower vein strikes N. 30° W. and dips to the north-east at 60 degrees; it is at an elevation of 1,200 feet.

The No. 3 vein as shown in an open-cut is 12 inches wide, while 30 feet west of this a tunnel 60 feet long has been driven on the vein, which varies in width from 2½ feet to 1 foot at the face. The vein is sparingly mineralized, principally with zinc-blende. A sample from the tunnel dump assayed: Gold, trace; silver, 2.8 oz.; copper, *nil;* zinc, 3.8 per cent.

At an elevation of 1,240 feet an open-cut has been made on the No. 3 vein, and from this a 15-foot tunnel put in. A picked sample from the ore-dump assayed: Gold, 0.02 oz.; silver, 47.2 oz.; copper, trace; zinc, 6.1 per cent.

Work was being carried on in July, 1916, on another vein at an elevation of 1,600 feet. A shaft, which was then down about 20 feet, was being sunk on the intersection of a 4-foot vein with a 12-inch cross-vein. A sample across 4 feet of vein-matter in the shaft assayed: Gold, trace; silver, 1.2 oz.; copper, trace. A selected sample from the ore-dump returned: Gold, 0.02 oz.; silver, 17.2 oz.; copper, trace.

Silver Standard. This mine is situated on Glen mountain, about four miles from Hazelton, connection with which is secured by means of a good wagon-road. The mine was operated nearly continuously

from 1910 to August, 1914, when, owing to war conditions, it was closed down indefinitely. The 1914 report of the writer contains an account of the mine, its development and production up to that time.

In the summer of 1915 the mine was reopened under the management of W. G. Norrie and substantial progress has since been made. The same syndicate, consisting of Stewart, McHugh, McLeod, and others, still owns the mine, and the general manager is D. McLeod, with office and headquarters in Vancouver. Development of the mine has been steadily carried out by Mr. Norrie, and at the same time continuous ore shipments have been made; during the past year (1916) the first shipments of zinc ore from the mine were made, and this also is the first zinc ore to be shipped from the Omineca Division.

When work was recommenced at the mine one of the first things started was a systematic resorting of the second-class ore previously sorted out from the shipping-ore. From these old dumps a considerable tonnage of shipping-ore has been obtained, a large part of the zinc shipments being obtained in this way. Mining and ore-extraction were also recommenced in the shaft, and a crosscut tunnel was driven which will be described later.

The production for the year 1916 was about 651 tons of silver-lead ore shipped to the Trail smelter, containing 126 oz. gold, 74,593 oz. silver, and 162,051 lb. lead; and 209 tons of zinc-silver ore shipped to the United States, containing 168,616 lb. zinc and 12,647 oz. silver. The total production of the mine to date is given in the following table:—

Year.	Tons.	Gold.	Silver.	Lead.	Zinc.
		Oz.	Oz.	Lb.	Lb.
1913	282	59	38,839	134,953	...
1914	736	200	121,944	282,033	...
1915	154	41	26,699	54,877	...
1916	860	126	87,240	162,051	168,616
Totals	2,032	426	274,722	633,914	168,616

In all, there are about nine veins on the hill which have approximately, but not entirely, parallel strikes.

This series of veins is best described as consisting of a number of true-fissure veins which are filled with a white quartz gangue carrying galena, zinc-blende, and subsidiary amounts of tetrahedrite, pyrite, arsenopyrite, and chalcopyrite. It has been noted in many parts of the world that where one quartz-filled fissure vein is found, there is quite often a series of roughly parallel veins which are quite close together; the veins on the *Silver Standard* form a typical example of this parallelism. It is hardly to be expected, and, indeed, rarely happens, that all the veins of such a series can be profitably worked, but where one is economically valuable, some of the others in the series generally repay exploitation. In the case of the *Silver Standard* most of the work has been devoted to one vein, but at least three others have yielded high-grade ore which has been shipped to the smelter.

The main vein has been described as "a compound vein, with quartz veins developed on either wall, and with bunches and stringers of quartz lying irregularly between." From work done during the past year it is now evident that these two quartz veins, respectively called the foot-wall and hanging-wall veins, are not quite parallel, but that they intersect at a point to the south-west of the shaft. At the shaft these veins are about 40 feet apart. The area between was evidently fractured in a subsidiary manner by the forces which made the main veins; irregular seams and fissures were made, which in many instances are roughly parallel to one of the main veins, but in other cases are striking in various directions, and in these some good, but small, shoots of ore have been discovered.

The silver-lead ore shipped to the smelter carries from 17 to 20 per cent. zinc, and a penalty of 50 cents a unit is charged for all zinc in excess of 8 per cent. This charge, together with smelting cost, wagon-haulage, and railway and boat transportation from Hazelton to Trail, brings the total costs of smelting and transportation up to somewhere about $30 a ton. When the cost of mining is added it is evident that nothing but closely sorted ore can be shipped at a profit. There is, however, a lot of ore which carries values from $15 to $20 a ton in which the mineral is so disseminated in the rock that it cannot be hand-sorted. For this ore mechanical concentration would be needed.

The shaft-workings on the main vein total in all about 3,500 feet, and it is estimated by the management that there has been disclosed by this work some 5,000 to 6,000 tons of ore of a milling grade. It is hoped, therefore, that with further work on some of the other veins a sufficient tonnage may soon be demonstrated to warrant the erection of a small concentrator.

As the ore contains galena, sphalerite, grey-copper, pyrite, and arsenopyrite, it will probably prove a difficult ore to treat so as to make a high extraction of the values. The ore is, however, high-grade, so there would not be a necessity for making a very clean separation of the quartz gangue, and hence a rough concentration which would remove a considerable proportion of the gangue would suffice to make a concentrate that would easily stand shipping costs.

The ore is not unlike that of the Silverton Mines Company's property, where, after many experiments and disappointments in milling the ore, very fair success has been obtained by the use of an oil-flotation process. At this mill by a judicious combination of tables and oil-flotation a good separation of the zinc from the lead has been attained.

The crosscut tunnel was started at an elevation of 1,581 feet and strikes the main vein at the 250-foot shaft level. In all, five veins have been crosscut, and the main vein is expected to be cut at a distance of about 850 feet. Some of these veins show good ore on the surface, and while but little or no work has been done on them from the crosscut level, it is understood that some of them look promising. These veins, with development, may be expected to show ore of a milling grade. They vary in width from a few inches up to a maximum of about 6 feet; from 1 to 3 feet is the usual width.

The main vein has been developed by a shaft which follows down on the foot-wall vein; in consequence it is not regular in dip and is more of a prospecting-shaft than a working-shaft, and a further disadvantage in using it as a working-shaft is that it is only equipped with a small hoist operating a bucket. Between the 250-foot level and the surface there is a considerable tonnage of ore which could probably be handled at a profit if mined cheaply. For this reason, as well as to prospect the other veins, the crosscut tunnel was driven, which taps the main vein at the 250-foot level at a point south-west of the shaft. To have driven a tunnel which would have tapped the bottom of the shaft or still lower would have meant a considerably longer crosscut, which at the time was not considered advisable by the management. In addition to the work of driving this tunnel and sorting over the old dumps, throughout the year work has been steadily prosecuted from the shaft. A good deal of work was done in the lowest or 400-foot level of the shaft-workings in following up and extracting streaks of high-grade ore. Other levels of the shaft-workings were also worked, and in all several car-loads of high-grade ore were taken out and shipped.

Wright Coal Co.

The property of the Wright Coal Company, consisting of about twelve claims, is situated near the station of Seaton, on the Grand Trunk Pacific Railway, and about twenty-two miles from Hazelton. Coal-bearing beds of the Skeena series are here found in a rather shallow but fairly regular basin, with a total length of about four miles and a half and a maximum width of about one mile and a half. The property was formerly owned by the Seaton Coal Company, and before that it is believed the name was the Grand Trunk British Columbia Coal Company, Limited.

Coal was discovered here many years ago, the seams being exposed along the banks of the Bulkley river. In all, ten or eleven small seams have been found, occurring in about 500 feet of sandstones and shales. These seams range in thickness from 1 to 3½ feet and are lying quite regularly and with little or no distortion. The average strike is N. 66° to 74° W. (mag.), with a northerly dip of about 30 degrees.

On the main seam a tunnel has been driven from the bank of the river for 230 feet, and at a point 120 feet from the portal a slope is down 30 feet, which had water in it at the time of examination. In the slope this seam has 2½ feet of coal on the roof, then a layer of bone 8 to 10 inches thick, and then 1 foot of coal on the floor. A sample across the 2½ feet of coal on the roof gave the following analysis: Moisture, 1.2 per cent.; V.C.M., 17.2 per cent.; F.C., 34.9 per cent.; ash, 46.7 per cent.

At other places this seam shows more bone or shale, as the following section at the face of the tunnel shows:—

	Inches.
Coal	9
Shale	5
Coal	8
Shale	2
Coal	5
Shale with a little coal mixed in it	18
Total	47

A sample was taken cutting across the three bands of clean coal and excluding the clay-bands and the bottom 18 inches, and the analysis of this is as follows: Moisture, 0.9 per cent.; V.C.M., 18.7 per cent.; F.C., 45.6 per cent.; ash, 34.8 per cent.

During last summer the company made preparations to sink a slope on this seam and prospect it thoroughly. The slope breaks through from the surface into the tunnel at a point 100 feet from the tunnel-mouth. A donkey-engine has been installed on the bench above the workings and only a few hundred yards distant from Seaton Station. This will hoist the waste material up the slope to the surface and take the coal on a tramway up the side-hill to the bench, 500 feet in distance and 170 feet higher elevation. At the time of visiting the property (July 12th) the donkey-engine was set up, the tramway being put in, and connection broken through from the surface to the tunnel, but work had not been started in sinking the slope below the tunnel-level. Nothing has since been heard as to how the work progressed.

Short prospect-tunnels have been run on two or three other seams, but it was not anticipated that any further work would be done on them in the immediate future. One of these tunnels is 87 feet long and shows a seam about 3 feet wide. A sample taken across 2 feet 10 inches at the face gave the following analysis: Moisture, 0.9 per cent.; V.C.M., 18.2 per cent.; F.C., 43.9 per cent.; ash, 37 per cent.

The analyses of the samples taken show an unduly high percentage of ash, and unless portions of the seams can be found which have a much lower ash content the value of this coalfield is problematical. Coal with such high ash is not of much commercial value, and at least it would have to be cleaned by washing before marketing. It will be also noted that the seams are barely above the economic limit in width.

The following table of analyses of samples, taken by W. W. Leach, of the Canadian Geological Survey,* also shows a high ash content for these seams:—

Sample.	Moisture.	Vol. Comb. Matter.	Fixed Carbon.	Ash.
No. 1. 15-inch seam	1.02	25.70	52.96	20.32
No. 2. 18-inch seam	1.39	25.56	50.06	22.99
No. 3. 20-inch seam	1.12	33.70	51.72	23.46
No. 4. 38-inch seam	2.15	22.03	43.66	32.16
No. 5. 20-inch seam	1.36	25.18	55.41	18.05

TELKWA.

The town of Telkwa is situated on the Grand Trunk Pacific Railway at the confluence of the Bulkley and Telkwa rivers. This town has apparently improved a little in the last two years, and the railway-freight business from this point is gradually increasing. The adjoining town of Aldermere, situated on a bench half a mile behind Telkwa, has been entirely abandoned, everybody moving down to Telkwa. This has assisted by centralizing all the business in Telkwa. There are now three general stores there, which keep a very complete stock of goods and apparently do a good business; in addition, there are some smaller stores.

Telkwa is surrounded by some very fair agricultural country, and the production is increasing and will continue to still further increase. An annual fall fair is held at which the farmers can show a large variety of agricultural produce.

There are no mining camps close to Telkwa, but at the same time the town is an outfitting-point for prospectors and several camps, at which work has been carried on intermittently during the last few years, purchase their supplies from the Telkwa merchants.

The town is compact, and now that Aldermere is defunct there is no near-by rival to prevent the centralization of the trade in one place. Hubert, four miles away—a railway town—is about in the same condition as Aldermere.

The railway divisional point (Smithers) is apparently a larger place than Telkwa, but the business done is about the same in amount. There is room for both these places to grow and prosper, and a healthy co-operation should take the place of rivalry.

The Grand Trunk Pacific Railway has not yet gone ahead with the plans for building a big station, yards, etc., at Smithers, but it will come in time. The mining camps on Hudson Bay mountain are tributary to Smithers, and possibly also some of those in the Babine range. The ranches all along the Bulkley valley are gradually increasing their production and making more business for the towns, but this growth is slow.

HUDSON BAY MOUNTAIN.

Several properties on both sides of Hudson Bay mountain were described by the writer in his 1914 report. None of these were revisited during the summer of 1916, but some other claims were examined and the following descriptions of them written.

The claims examined are located on the north-eastern slope of Hudson Bay mountain, and most of them are as yet undeveloped prospects. The first property visited was that of Jennings Bros., situated near Lake Kathlyn, and the others were the Schufer and Martin claims near the top of the mountain.

Lone Star Group.

A group of six claims situated one mile and a half from Lake Kathlyn in a south-westerly direction, and owned by Jennings Bros., is known as the *Lone Star* group. Lake Kathlyn is a small but beautiful lake on the line of the Grand Trunk Pacific Railway about three miles north-west of Smithers, a railway divisional point. It is said to have been the

* Summary Report of Geological Survey Branch, 1910, page 100.

intention of the Grand Trunk Pacific officials to make this into a tourist resort, but as yet nothing has been done and the place is only a flag-station. Nevertheless, the place is very popular with the Smithers people, who go there for summer camping, picnic parties, etc.; it is a particularly pretty place and the lake provides bathing, boating, and fishing.

The old name for the lake was Chicken's lake, but as a preliminary to advertising the place as a "scenic resort" the Grand Trunk Pacific publicity agent succeeded in inducing the Geographic Board to substitute the more artistic name of Lake Kathlyn; this latter is now therefore the official name for the lake and the station. It is therefore to be hoped that in the future the "fair Kathlyn" will not be dubbed a "Chicken."

Jennings Bros. own a considerable piece of land around Lake Kathlyn and run, in a small way, a stopping-place for visitors. They have quite an extensive garden in which they grow a large variety of market produce. Amongst various other lines of work the Jennings have taken up a group of claims and carried out considerable development-work. These claims are situated one mile and a half from their house on Lake Kathlyn in a direction right up Hudson Bay mountain, and are on a small creeklet known as Jennings creek. The workings are at an elevation of 2,575 feet, and the claims are in the same locality as the *Empire* group, described by the writer in his 1914 report.

The formation consists of andesitic tuffs, breccias, and highly altered sedimentaries; in many places the rocks are decomposed, crumbly, and badly weathered. Some lines of shearing and sheeted zones can be seen, but at no place is there any great width of crushed rock. The most predominant strike noticed was N. 50° W. (mag.), with a south-westerly dip of 60 degrees. Slight mineralization has taken place along cracks and narrow shears, but no continuous streak of ore of appreciable width has yet been found. It was hoped by the Jennings Bros. that there was sufficient mineral disseminated all through the rock-matter to make a large low-grade body of ore, but, while this is a possibility, it cannot be said that such is yet proven.

Three tunnels have been driven in, two on the north side of the creek and one on the south, which prospect likely-looking mineral-bearing zones. The tunnel on the south side is 100 feet long, with a 22-foot crosscut from the end. This working shows a little mineral in seams an inch or two wide. The upper tunnel on the north side is 70 feet long and the other one is 150 feet long. The solid galena that is found occasionally in the small seams carries nearly an ounce of silver to the unit of lead. A little zinc-blende is sometimes also found.

Schufer Property.

This group of claims, owned by Peter Schufer, is situated on the north-western slope of Hudson Bay mountain, about nine miles by pack-trail from Lake Kathlyn. This property was bonded a few years ago to the Hudson Bay Mining Company, the first work being done under the superintendence of Colonel Steele, and some further work later on by Mr. Bromly. Owing to the refusal of the owner to extend the time of and lower the price of the bond, Mr. Bromly gave up the company's option on the property two years ago. Since that time very little work has been done.

The main showing is a body of zinc-pyrrhotite ore occurring in a vein or mineralized zone in a formation consisting of altered volcanic rock. This ore-body is exposed by two open-cuts 50 feet apart and an 18-foot shaft (full of water). The width is from 15 to 20 feet and the length exposed about 100 feet. Further work may show that this ore-body has a greater length than 100 feet. The vein, which shows as a rusty iron-capping, has been traced down the gulch from the main showing, and at an elevation 100 feet below the collar of the shaft a tunnel was driven in 135 feet by Mr. Bromly. This tunnel apparently is driven on the vein, but it shows no appreciable amount of sulphides, the rock from the tunnel being silicified country-rock. This tunnel is 80 feet short of being under the main showing, and

it was to drive this additional 80 feet that Bromly desired an extension of the company's option on the property.

The zinc-pyrrhotite ore in the main showing will assay from 10 to 15 per cent. zinc, and it is not believed that it carries high values in either gold or silver. Sample No. 44 is an average across 14 feet of the main showing, and this assayed: Gold, 0.14 oz.; silver, 1.5 oz.; lead, *nil;* zinc, 16 per cent. An average sample of the whole dump from the open-cut and shaft returned: Gold, 0.02 oz.; silver, 1.4 oz.; lead, *nil;* zinc, 13 per cent. These two samples give a fair idea of the grade of ore in the main showing.

There is another vein on the property which is developed by open-cuts and an 80-foot tunnel. This tunnel shows no ore and this vein cannot be considered to be of as much value as the other one.

A crosscut tunnel at a point a long way below the main showing was driven in 400 feet by Colonel Steele. This is waste work and is of no value in proving any of the ore-showings on the property.

The ore now exposed on the property is low-grade zinc ore and cannot be marketed in its present condition. It would have to be concentrated and such concentration may prove to be difficult. As yet there is not sufficient ore proved up to warrant the erection of a concentrator.

The property requires further development, and this development can be carried out quite well by hand-work. As no machinery is required, the present mode of transportation by pack-trail is quite sufficient to allow development of the property for some time to come.

White Heather Group.

This group of four claims is owned by Frank Martin and is situated above the Schufer property at an elevation of 6,900 feet. The formation consists of a peculiar reddish-coloured volcanic breccia, in some places porphyritic, and the ore is found in small irregular fissures which are often faulted considerably in small step-like faults.

The main showing is a vein which varies in width from a mere seam up to nearly a foot, which has been developed by open-cut stripping and one shallow shaft or prospect-pit. The valuable minerals found are bornite and grey-copper and occasionally some native silver. This vein is cut into slabs of about 10 feet in length by fault-planes, and it is very evident that the ore is better near where a fault-plane intersects the vein. Mineralization also occurs in places along the fault-planes. It would seem as if the ore now found was of a secondary nature, formed after the faulting had taken place, but this is by no means certain.

Where the vein is well mineralized it is as a rule quite small, so that the total amount of ore is not great. A few tons of ore were shipped at different times in the past from this property, and during the summer of 1916 Mr. Martin had taken out a few more tons which he expected to pack out in the fall. The ore is, of course, closely hand-sorted before shipping, and this sorted ore contains a high percentage of copper and often high values in silver. A representative sample of this shipping ore taken by the writer assayed: Gold, 0.45 oz.; silver, 120.1 oz.; copper, 47.8 per cent.

Two hundred feet east of the main showing there is another vein striking N. 20° E. which is from a few inches up to 2 feet in width. The vein-filling is mainly gangue-matter somewhat decomposed and carrying a little chalcopyrite and a lot of limonite, and somewhat stained with malachite and azurite. A sample across 2 feet of this vein gave the following assay: Gold, trace; silver, 1 oz.; copper, 4 per cent.

Bonanza.

This claim is located farther over the ridge from the *White Heather* group and on another slope of the mountain. There is on this claim a small vein very similar to that on the *White Heather,* except that the bornite does not carry as high silver values. The only development is some open-cuts and stripping up and down the gulch in which the vein is exposed.

HUNTER BASIN.

As far as could be learned, there had been very little new work done on the claims in Hunter and Hankin basins since they were examined and reported on by the writer in 1914, and therefore they were not revisited during 1916. Later in the year it was heard that the *Hunter* group, or holdings of Wm. Hunter, were bonded to a company which immediately commenced work on them. The report of J. D. MacKenzie, previously mentioned, contains a good description of the more important showings in Hunter basin.

HOWSON BASIN.

Howson basin is situated at the head of Howson creek, a tributary coming in from the west to the South fork of the Telkwa river. It is distant about twenty-eight miles from Telkwa, and is reached by a trail following up the main Telkwa river and then the South fork of the river to its headwaters.

Mineral claims were staked in this district many years ago, and also coal-showings were partially prospected, but the district was quiet for a long time. A report on the district was made by W. W. Leach in 1906, published in the Summary Report of the Geological Survey for that year. From this report the following quotation is taken:—

"Another and larger area of intrusive rocks occurs near the head of Scallon creek, an important tributary to the South fork of the Telkwa from the west, extending across the divide to the headwaters of the Morice and main branch of the Telkwa. This rock has sent out numerous dykes in all directions into the surrounding volcanics, and has also caught up and included in it many patches of the latter. Near the contact of these two formations and along the dykes from the former, a large number of mineral locations have been made, including the *Duchess*, the *Anna-Eva*, and the *Evening* groups on Howson creek, the *Starr* group on Starr creek, and numerous other claims."

The camp was examined by W. Fleet Robertson in 1911 and a report on it can be found in the Annual Report of that year. The writer was unable to find time to personally visit Howson basin, but his assistant, D. A. MacKinnon, spent two days there, and from his notes the following report has been prepared. The principal operator is F. M. Dockrill, together with associates, and it is understood that he will haul out this winter on a sleigh-road some 300 to 400 tons of high-grade copper ore.

Briefly, the geology of the district is that the rocks of the Hazelton formation, here consisting largely of volcanic and tuffaceous rocks, have been intruded by dykes of a granitic rock which come from stocks of granodiorite belonging to the Bulkley eruptives. Mineralization has followed these dykes, sometimes in the older rocks near the dykes, but more often along the walls and through the body of the dykes. Some of the ore-bodies are of the replacement type and are characterized by a development of epidote and calcite. The gangue consists largely of the decomposed and highly altered wall-rocks, together with small quartz stringers. Chalcocite, bornite, and chalcopyrite are the important ore-minerals, and in addition pyrite and hæmatite are found. Copper is the principal valuable metal present, the values in precious metals being quite low.

Santa Maria Group.

The *Santa Maria*, *Kathrina*, *Telkwa*, and *Howson* claims constitute the *Santa Maria* group, which is under bond to Jefferson & Dockrill. The property has a fairly well-defined vein averaging about 4 feet in width, and striking N. 30° W. and dipping at 70 degrees to the west, which cuts through a volcanic rock formation. Open-cuts expose the vein at intervals for a distance of about 250 feet. At an elevation of 4,330 feet a shaft has been sunk on the vein, which, at the time of visiting the property, was down 38 feet. Work was being continued in sinking this shaft.

The hanging-wall of the vein is definite, but the foot-wall is irregular and discontinuous. The vein as exposed in the shaft seems to be made up of a number of parallel stringers, which are all, in places, well mineralized; but the pay-streaks in each stringer are discontinuous and break off abruptly. Chalcocite is the most important mineral found, but other sulphides of copper and iron also occur.

A sample across 4½ feet of the vein taken at a point 35 feet down the shaft assayed: Gold, trace; silver, 7.5 oz.; copper, 12.2 per cent. From the material taken from the shaft about 50 tons of good ore had been hand-sorted and piled on the dump; a grab sample of this dump was taken which assayed: Gold, trace; silver, 13.2 oz.; copper, 21.7 per cent.

Work was continued steadily on this property all fall, and it is believed several hundred tons of high-grade copper will have been shipped during the winter months. A rough sleigh-road has been constructed, and over this the ore will be hauled to Telkwa and then shipped.

Duchess Group. This group was one of the first locations in Howson basin and was held by the Telkwa Mines Company; it is now under bond to Jefferson & Dockrill. The ore-bodies are found in dykes which cut through volcanic rocks of an andesitic character. Mineralization with copper and iron sulphides has taken place along the walls of the dykes, and in places throughout the dykes. These ore-bodies are admittedly low-grade—i.e., from 1 to 5 per cent. copper—but may be shown to be quite extensive. Further development is being proceeded with in order to determine the amount of ore existing.

The present development consists of two tunnels, one of which is 400 feet long, and some surface cuts. Considerable mineralization is evident in the long tunnel for 90 feet, but no sampling was done. It is claimed that considerable ore in this working averages 4 per cent. copper, and that some streaks carry 11 per cent. copper. The claims are at an elevation of 4,700 to 5,000 feet. The hill is much shattered by the intrusive dykes, and therefore should be a likely locality in which to find large ore-bodies. These dykes are called "green dykes," the name describing their prevailing colour. From an examination of a hand specimen they are fine-grained and only slightly porphyritic; they now contain a good deal of epidote and some chlorite, and probably originally had about the composition of a diorite. The rock through which they intrude has a general reddish colour, is in places porphyritic, sometimes brecciated, and occasionally amgydaloidal.

Cassiar Crown Copper Co. About two years ago the Cassiar Crown Copper Company secured a lease and bond on the claims on Grouse mountain, which are owned by Samuel Bush, Louis Schorn, and other partners. These claims were described by the writer two years ago under the name Bush group.* At that time they had only been staked a few months, and shortly after the writer examined them they were bonded by Trimble & Anderson, who formed the above-named company.

In 1915 J. D. MacKenzie, of the Geological Survey, examined this property in some detail. His report on it is in the 1915 Summary Report of the Geological Survey and includes a contoured geological map of the claims. His report is so complete that little further need be said. It may be pointed out that his accompanying map has, probably through a printer's error, a wrong scale on it. The scale as given is 5 miles to the inch, but it is evident that the actual scale of the map is about 5 inches to the mile.

The concluding sentence of his report says: "This deposit, so far as it has been prospected, is of a promising appearance, and is also favourably located with regard to transportation, as it lies on the very edge of the Bulkley valley, with the railway across the river only four miles and a half distant in an air-line."

The first work done by the Cassiar Crown Copper Company was to sink a shaft at a point where there was a good showing of ore. This shaft is 56 feet deep and had water in it when the writer examined the property in July, 1916. This working

* Annual Report of Minister of Mines, 1914, page 227.

shows several streaks of good ore, but in general the whole rock taken from the shaft is mineralized. To judge by the eye, the rock taken out, which now forms the dump, would assay from 3 to 4 per cent. copper. A rough grab sample of the whole dump was taken which, however, will only give a very rough approximation at an average sample; this assayed: Gold, trace; silver, 2.6 oz.; copper, 2.5 per cent.

The company apparently considered that the indications of ore as shown by this prospect-shaft were sufficiently encouraging to warrant a more extensive development plan. A small gasolene-driven compressor was installed and work commenced on a crosscut tunnel, which is 300 feet lower than the collar of the shaft and is distant 500 feet in a horizontal direction. This tunnel may possibly strike stringers of ore before getting vertically underneath the shaft. The face of the tunnel at the time of examination was in about 100 feet and was in a hard, dense, flint-like rock, which is a highly silicified volcanic tuff or tuffaceous quartzite.

The following is an excerpt from Mr. MacKenzie's report: "The metallic minerals, which are chalcopyrite and zinc-blende, are localized in a sheeted zone, which is in general parallel to the strike of the sediments and nearly vertical. The joints (sheets) of the zone show little or no slickensiding and are spaced from a fraction of an inch to several inches apart. The ore-minerals are found in narrow fissure-veins, representing filling of the openings in the sheeted zone, and also as irregular replacement veins and masses throughout the zone. There is a little quartz gangue associated with the sulphides. Well-defined walls were not observed for the deposit as a whole, though they are present locally. This ore-bearing, sheeted zone has been broken by post-mineral faults, usually of only a few feet displacement and nearly vertical. Those observed are roughly parallel to the strike of the dykes and the direction of the schistosity in the sediments. Proceeding east along the zone, it can be seen to be offset to the north along the faults, and from the areal distribution of the ore-minerals it is thought that the western portion of the zone may be affected by faults of greater displacement than those observed elsewhere.

"With respect to the tenor of the ore but little definite information is available, as no systematic exploration nor assaying has been done. The following descriptions of some of the prospect openings will serve to give an idea of the character of the more highly mineralized portions of the deposit:—

"At the initial post of the *Copper Crown* claim a sheeted zone 12 feet wide is made of closely spaced joints from ½ to 4 inches apart, most of which can be traced on the surface for 10 feet, and in some cases two or three times that far. Chalcopyrite occurs in the fissures in this zone, forming lenticular and irregular veinlets of the solid mineral, the largest seen being 3 inches thick by 16 inches long. A shoot in the zone, 3 feet thick and 10 feet long, contained about 20 per cent. chalcopyrite, and other less-rich shoots also occurred. Twenty-two feet east of the place just described a 2-foot pit shows a shoot 4 feet thick, visible for 10 feet, which contains about 25 per cent. chalcopyrite, and a 10-inch vein in the middle of the shoot, exposed for 5 feet, is nearly pure chalcopyrite. At a distance of 190 feet from the initial post mentioned the continuation of the same zone is 35 feet wide, prospected by a shaft on the south side of the zone and a trench on the north side. The shaft is 5 x 6 x 8 feet deep, and exposes a 5-foot shoot that may run 20 per cent. chalcopyrite. The rest of the 35 feet is lower-grade ore, except for one or two small shoots up to 18 inches thick. Eastward from here for a distance of about 100 feet are many short veinlets of chalcopyrite from ½ to 4 inches thick.

"At the east end of Coppermine lake, on the *Eureka* claim, a shaft 6 x 5 x 8 feet deep and some trenching expose a 10-foot mineralized zone in greenish tuffs, which is probably the continuation of the one just described. The zone strikes N. 80° E. and

dips about 75 degrees north. Following is a section of the zone, from the hanging-wall to the foot-wall:—

"Chalcopyrite, pyrite, and quartz ..... 6 inches.
Rock, slightly and irregularly mineralized ..... 6 inches.
Ore-shoot, about 25 per cent. chalcopyrite ..... 2 feet.
Rock, slightly and irregularly mineralized ..... 2 feet.
Ore-shoot, about 25 per cent. chalcopyrite ..... 5 feet."

BOB CREEK.

Buck river flows into the Bulkley river at Houston, a station on the Grand Trunk Pacific Railway thirty-one miles east of Telkwa. Ten miles up the Buck river from Houston a small tributary comes in which is called Bob creek. About half a mile from where it joins Buck river, Bob creek flows through a narrow canyon which has been cut down by the creek. At different times some placer-mining has been done on this creek, mostly near the foot of the canyon; some of this work was done in recent years and some of it may date back to forty years ago. Various stories are heard as to the results of this work, but it is fairly certain that some placer gold has been taken out of the creek. The origin of this gold is supposed to be in a belt of volcanic rocks some 1,500 to 2,500 feet in width which are cut across by the creek where it flows in the canyon. Evidence of this is said to be shown by the fact that no placer gold is found in the creek-gravels farther up the stream above these rocks.

This belt of rocks is known locally as a "porphyry dyke," and claims have been staked covering the locality of outcrops and some prospecting has been done. The rocks appear to be true volcanic rocks consisting for the most part of volcanic breccias and andesite. They have a general north-west strike, but strikes and dips of joints and fracture-planes can be seen going in all directions. No distinct flow-structure can be seen nor can lines of separation of different lava rocks be easily seen. As a rule, the rocks where shown on the sides of the canyon are soft and crumbly and contain a considerable percentage of iron oxide or limonite, which has probably resulted from the oxidation of original iron sulphide. There seems to be no question that certain zones or streaks in these rocks carry some gold values, but the writer was quite unable in the short examination he made to determine just how these ore-bearing zones originated. These rocks from their lithological appearance may belong to a horizon of the Hazelton series, which is almost entirely made up of volcanic rocks, but they may be of much later age—possibly Tertiary. If, however, they belong to the Hazelton series, then, in common with these rocks as occurring in other localities, they could have been subjected to fracturing and mineralizing agencies.

No definite veins, sheared zones, nor sheeted zones can be seen, and what mineralization there is is quite scattered, irregular, and also very slight. Metallic sulphides are very scarce, but from the presence of considerable secondary iron oxide, it is evident that iron sulphide was present at one time. Minute amounts of zinc-blende have been found in concentrates from panning samples from certain zones of the rock. The only work which has been done is a number of prospect holes and cuts from which many samples have been taken.

As yet, however, no systematic sampling to find out the average grade of the whole body of volcanic rock ("dyke") has been done which is considered conclusive. It would not seem as if there was any small area or zone which carries sufficient gold values to make small-scale mining possible at a profit. The only possibility is that the whole "dyke" is sufficiently mineralized to make a large low-grade ore-body. While this possibility is problematical, further testing is required.

BABINE RANGE.

The Bulkley river rises in Bulkley lake and flows nearly north-west to the Skeena river at Hazelton. It marks a divisional line between the Rocher Déboulé and Hudson Bay mountains and the Babine range, which latter extends from the

Suskwa river (a tributary of the Bulkley coming in ten miles above Hazelton) to Telkwa, from whence these mountains gradually fade away. This range reaches elevations of 6,000 to 8,000 feet in the neighbourhood of the Suskwa river, and then gradually decreases in height towards Moricetown, where it consists mainly of ridges covered with scrub timber. Continuing south-easterly, it again rises to high peaks in the vicinity of Driftwood, Deep, and Canyon creeks. Immediately to the east of the Babine range is Babine lake, which parallels the range for a distance of 105 miles.

Mineral discoveries have been made in many places in the Babine range, but the difficulty in arranging for suitable transportation has retarded development. Cronin's mine was re-examined during the year; the *Debenture* group, active development of which was started in July, was visited and also the gold-quartz camp at Dome mountain. These will now be described.

Babine-Bonanza Mining and Milling Co.

The property owned by the Babine-Bonanza Mining and Milling Company is popularly known as "Cronin's mine," the reason being that James Cronin is heavily interested in the company and is also manager of the mine. This property was described in detail by the writer in his 1914 report. Since that time further development-work has been carried out by Mr. Cronin, and shipments of ore would probably be now commenced if suitable transportation arrangements were provided.

In his 1914 report the writer said: "The ore-bodies on this property occur at and near the contact of a granite porphyry with a series of highly altered sediments of the Hazelton group." In this the opinion previously expressed by W. W. Leach, of the Geological Survey, was concurred in, but from a second examination the writer is not at all so sure that the rock labelled "granite porphyry" is so. The rock in question is a highly siliceous, fairly fine-grained rock, and some hard specimens are nearly identical with quartzite. Other specimens, however, show small crystals of biotite mica, and this fact may have caused it to be called a granite porphyry. The writer took several specimens which will be examined microscopically in thin section and the exact character of the rock will be found. This has not been done in time for this preliminary report, but will be given later.

No further work has been done in the shafts described in the former report, but the tunnel (No. A tunnel) which was in 33 feet in 1914 has had a good deal more work done on it. This tunnel went in for a short distance in slide-rock and then for 25 feet crosscut obliquely a body of good ore. The tunnel was then continued for 173 feet and at that point struck the No. 2 shaft vein. Where encountered this vein was small, but drifting on it was being commenced when the writer was on the ground.

The large ore-body cut near the mouth of this tunnel appeared so promising that the management decided to run a crosscut from the lower main tunnel (No. 1) to prospect the ore-body at greater depth. The lower main tunnel is situated 100 feet below the No. A tunnel, is in some 400 feet, and was driven several years ago as a drift prospecting the first vein found on the property. Accordingly a crosscut was run from it to a point underneath the large ore-body, but while no appreciable ore was found, this work is not conclusive proof that there is no downward continuation of the ore-body in No. A tunnel. More work is now being done on and near the surface to find out the exact strike and dip of this ore-body, so that it will be possible to calculate more exactly where the ore should be on the main tunnel level. In furtherance of this idea a prospecting-tunnel was being driven at a point 60 feet from tunnel A and at an elevation 30 feet lower. This tunnel was only in a short distance, but showed ore in the face of a good milling grade. This tunnel is apparently running on the strike of the ore-body in tunnel A, and it was the intention before long to crosscut so as to determine the width, character of wall-rock, dip, etc.

The ore-body exposed in tunnel A and the prospect-tunnel below has evidently been formed in the contact between a siliceous rock and a black schistose rock of

argillitic composition. (This siliceous rock was in the writer's 1914 report called a granite porphyry.) This same contact deposit is exposed at various places on the surface. It occurs on the sloping side of the hill, and it would appear as if in most places the schistose rock had been eroded off and left the ore exposed lying on top of the siliceous rock. The contour of the hill thus conforms roughly to the dip of the ore-body and of the contact.

From these showings of ore a considerable tonnage of galena could be hand-sorted and shipped if suitable transportation were available, but eventually with further development, if sufficient tonnage is demonstrated, a concentrating-mill would be the best way of handling this ore.

A vein on the eastern side of the hill which has been developed by a shallow shaft and tunnel has some nice-looking ore exposed in it. Work is being done on this vein also and it seems to promise well for the future.

Still another vein is exposed on the eastern side of the hill roughly parallel to the one just described, but nearer to the main workings. Practically no work has been done on it, principally because Mr. Cronin has been too busy elsewhere. It is, however, a promising-looking vein about 4 feet wide and carrying in places bands of galena up to 2 feet in width. The galena here is said to assay 3 or 4 oz. of silver to the unit of lead.

Mr. Cronin is thoroughly familiar with the country and has spent considerable time in cruising out various routes for a wagon-road from the mine to some point on the Grand Trunk Pacific Railway. The great difficulty to be overcome is that, as the property is on the Babine Lake slope, there is, therefore, on most routes an adverse grade against the ore in taking it over the divide of the Babine range to the railroad in the Bulkley valley. The route of the present trail up Driftwood creek and over the divide was obviously impossible, and the route of the old trail from Moricetown also proved to be inadvisable. For a time the possibility of taking the ore down to Babine lake, thence to the head of the lake and out on a wagon-road to Burns Lake on the railway, was considered, but this also was finally considered impracticable.

The route now decided upon by Mr. Cronin is from the mine down Cronin creek for about five miles in a south-easterly direction (towards Babine lake), then swinging southerly and westerly and coming out through a low pass in the Babine range lying between Deep and Canyon creeks, and thence into Telkwa, a total distance of about thirty miles. In July, 1916, Mr. Jens, a Public Works engineer, surveyed out this route and reported it feasible, and that at no place would there be an adverse grade against the ore being hauled out. This road will also open up about ten miles of agricultural country east of Telkwa, in which there are now some settlers, and also will assist further prospecting in the Babine range.

It is understood that Mr. Cronin during the fall of 1916 had this road slashed out and partially completed so as to serve as a sleigh-road in winter. The writer's information at the time of writing this (in December) is that the road lacks three or four miles of being completed as a snow-road, and therefore it is not anticipated that any ore will be hauled out in the winter of 1916-17.

There are several good veins and showings of ore on the property, and there is no doubt that, with a wagon-road, the property should be able to ship hand-sorted ore steadily. Eventually, however, the bulk of the ore will have to be concentrated before shipment.

Debenture Group.

This group of five claims is owned by Henry Bretzius and partner and is under bond to Thos. Rea and associates. It is organized as a stock company, with head office in Victoria, under the name of the Debenture Mining Company. The property is situated in the Babine range, on the Babine Lake slope, ten miles north-west of Cronin's property, and is at present reached by a twenty-eight-mile pack-trail from Moricetown.

The property is a prospect with very little development-work done, but has a most promising surface showing. It has a large vein showing up to 10 feet of

milling-ore, and in some places shoots of solid galena from 2 to 5 feet in width. The ore is galena carrying about an ounce of silver to the unit of lead and is very similar to Cronin's ore, with the exception that there is no zinc-blende present.

The main showings are in a bluff where it is impossible to do any systematic work, so Mr. Rea is now driving a crosscut tunnel which will be from 200 to 400 feet in length before striking the vein; it was in July in 60 feet. A camp with two good log buildings has been built and nine men are at work.

DOME MOUNTAIN CAMP.

At Dome mountain, in the Babine range, a number of claims have been staked on showings of quartz veins carrying gold. It was considered advisable from what had been heard as to the camp to make an examination of it, but the writer was unable to find time to personally visit the camp; he therefore sent his assistant, D. A. MacKinnon, who examined the more important showings. The following report on the camp is therefore based on notes written by Mr. MacKinnon. From his description and the assays obtained on samples taken by him it is evident that the camp is a promising one and should attract the attention of mining men.

Dome mountain, an isolated lone hill, deriving its name from its similarity in shape to an engine-dome, is situated about twenty miles easterly from Telkwa and forms a part of the Babine range. It rises to an elevation of about 5,300 feet, with timber-line at about 4,700 feet. At the present time a roundabout route is used to get to the camp, consisting of fourteen miles of wagon-road and thirteen miles of trail. By building about thirteen miles of new trail or road from the north end of Round lake to the camp a practically direct route of about twenty miles, from Telkwa to Dome mountain, could be obtained.

GEOLOGICAL FEATURES.

From an examination of a number of rock samples collected by Mr. MacKinnon it would seem as if the main formation on Dome mountain was a series of considerably altered and metamorphosed sedimentary rocks. Many of the samples are almost impossible to identify accurately from a hand sample, and a microscopic examination of thin sections of the rocks would be required to obtain an absolute identification. Most of the rocks have some lime in them, and one of them, taken from the *Bullion* group, is a straight limestone, although somewhat impure. The rocks have in places a partial schistose structure, and some of this schist would appear to have been originally of volcanic origin. It is probable that the rocks were originally a sedimentary series in which some volcanic flows had been intercalated and interbedded, and that now metamorphism has considerably altered them from their original character. The set of samples does not include any which appear to be plutonic rocks.

The formation on Dome mountain does not seem to bear much resemblance lithologically to the Hazelton series, and it is possibly an older formation. The presence of interbedded limestone would suggest that these rocks may be correlated with the Kitsalas series, but more information must be obtained before anything definite could be said.

The showings of ore are found in well-defined quartz-filled fissures, a number of which give evidence of being of a permanent nature. The veins vary in size from about 6 inches to 6 feet, and practically always contain a true quartz-filling. The metallic minerals which are found in the quartz are pyrite, arsenopyrite, a little chalcopyrite, and occasionally a little galena. The main values are in gold, but in some instances the silver content becomes appreciable, and assays showing copper up to 2 per cent. have been obtained. The camp must, however, be considered as a gold camp, as the other values are very subordinate to the gold.

No tests have been made yet to find out whether the gold is carried in the pyrite or other sulphides or is free in the quartz. It is probable, though, that some gold is

free, but that a large percentage of it will be found to be contained in the pyrite. Silver values might be expected to run up where there is some galena present.

The mixture of sulphides present will make the ore a little difficult to mill or concentrate, but no very great trouble should be experienced.

Bullion Group. This group, consisting of the *Bullion*, *Shamrock*, *Maple Leaf*, and *Pansy* claims, is situated on the easterly slope of Dome mountain; it is owned by J. Bourgone, T. J. Thorpe, J. Probendite, and G. Hazelton. The main showing is a well-defined quartz vein from 3 to 5 feet wide occurring in a band of altered sedimentary rock which might be classed as an argillaceous limestone. The strike of the vein is N. 35° E. and it stands approximately vertically. It is apparent that there are, besides the main vein, small subordinate stringers of quartz through the rock which are in places mineralized to some extent; these are, however, of lesser importance than the main vein.

By means of two short tunnels and an open-cut the vein has been exposed along a length of 100 feet. In the open-cut, which is the farthest opening to the north-east, the vein is 33 inches wide, and the following is the result of the assay of a sample cut across the full width: Gold, 0.48 oz.; silver, 2 oz.; copper, trace; lead, *nil*.

About 50 feet south-west of this open-cut a tunnel 30 feet long has been driven which cuts across the vein near the portal, and then goes on into the country-rock to where the argillaceous limestone is in contact with a more siliceous bed. The width of quartz showing in this working is 5½ feet, a sample across which returned on assay: Gold, 0.10 oz.; silver, 1 oz.; copper, trace.

About 45 feet farther to the south-west from this tunnel another tunnel has been started, which is in 12 feet. Here the vein shows in the upper part of the face; it is slightly bent over and is considerably leached out and oxidized, the lowest part showing more quartz than at the top. A sample across 30 inches of the leached matter assayed: Gold, 0.76 oz.; silver, 4.6 oz.; copper, trace.

Homestead Group. This group is also situated on the eastern slope of the mountain, and consists of the *Lucky Boy*, *Homestead*, *Gold Standard*, and *Snowflake* claims, the owners being T. J. Thorpe, J. Bourgone, J. Probendite, and G. Hazelton. The lowest showing on this group is on the *Lucky Boy* claim, at an elevation of 4,400 feet. Three open-cuts trace the vein for about 120 feet, showing a strong, well-mineralized quartz vein 4½ feet wide, which strikes N. 45° E. and dips to the south-east. The surface appears to be lying somewhat flatter than the real pitch of the vein. A sample taken across 18 inches of the vein on the foot-wall side returned the following values: Gold, 0.60 oz.; silver, 3.6 oz.; copper, 1.9 per cent.

At an elevation of 4,580 feet on the *Snowflake* claim a 15-foot open-cut shows a 24-inch quartz vein cutting through a schistose formation; this vein strikes N. 35° W. and dips to the east. The vein is badly leached out on the surface and is not shown except in this cut. A sample taken here across 24 inches assayed: Gold, 2.7 oz.; silver, 19.7 oz.; copper, 0.8 per cent.

About 100 feet north-west of this open-cut a tunnel has been started to crosscut this vein. It is in about 20 feet and has still 20 feet to go to reach the vein.

Pioneer Group. This group is also situated on the east slope of the mountain, and consists of the following claims: *Mohawk*, *Silver Fox*, *Lone Star*, *Black Hat*, and *Silver Tip*, owned by T. J. Thorpe, J. Bourgone, J. Probendite, and G. Hazelton. At an elevation of 4,750 feet an open-cut on the *Mohawk* claim shows several quartz stringers through the main schistose rock, with a strike N. 70° W. These stringers vary from 3 to 8 inches and some are well mineralized. A sample taken here across a 6-inch quartz stringer assayed: Gold, 0.46 oz.; silver, 3.3 oz.; copper, trace. Another from an 8-inch stringer returned: Gold, 0.36 oz.; silver, 25.4 oz.; copper, trace.

From this open-cut, following along the line of strike N. 70° W., the vein has been open-cut again about 800 feet to the west, but no intermediate cuts have been

made. This is at an elevation of 4,780 feet, about 100 feet above timber-line, but owing to the thick covering of earth over the hillside the vein cannot be seen except at open-cuts. This work is on the ground of the *Silver Fox* claim.

The vein here shows 20 inches quartz, with 24 inches of vein-matter mixed with rock on the foot-wall. The vein has the appearance of being slid over on the surface and has a dip of 45 degrees to the north. A sample taken across this 20 inches of quartz gave the following result: Gold, 0.56 oz.; silver, 15 oz.; copper, 1.2 per cent.

This is the middle vein on the hillside, a vein being found about 200 feet below, that is to the north-east, and another one about 400 feet higher up the hill. The veins are practically parallel and all are vertical. They are all very similar in character and mineralization.

At an elevation of 4,810 feet an open-cut on the upper vein shows 18 inches of vein-matter. This vein is opened by cuts in several places; a sample taken across 18 inches of the vein at the farthest north open-cut on the *Pioneer* group gave the following values: Gold, 0.36 oz.; silver, 1.6 oz.; copper, trace. The lower vein is also exposed in a cut on the *Pioneer* group, showing it to be the same character of vein as the other two.

La Petite Fraction.

This claim, owned by T. J. Thorpe, lies immediately to the north-west of the *Pioneer* group. A vein, apparently the upper vein of the *Pioneer* group, as it is on the same strike, is open-cut on this property at an elevation of 4,720 feet. About 60 feet west of this open-cut another vein is exposed, which is an offshoot of the main vein. It has a strike due west and is lying flatter on the surface than the other vein. A sample across 16 inches in the open-cut on this vein assayed: Gold, 6.56 oz.; silver, 10.2 oz.; copper, 2 per cent.

It is noteworthy that this sample contained a much higher percentage of sulphides than the others from the camp. This may account for the high gold values and would tend to show that the gold occurs in some of the sulphides.

What appears to be the lower vein of the *Pioneer* group is also found on this property. An open-cut and two 10-foot shafts show a 14-inch vein, considerably leached out and decomposed. This vein also stands vertical and has the general strike of N. 70° W. A sample taken from the most southerly shaft across 14 inches of this leached vein-matter returned the following results: Gold, 1.26 oz.; silver, 4.4 oz.; copper, trace.

North Star Group.

Adjoining the *La Petite Fraction* on the north-west is a group of claims consisting of the *Blue Grouse*, *North Star*, *Gold Seal*, and *Gold King* claims, and owned by T. Hyslop, B. Robinson, Ira McLean, and J. McKendrick. Three main veins cross these claims roughly parallel and with the same general strike—N. 70° W.—and about the same distance apart as the *Pioneer* group veins. They are considered to be extensions of the *Pioneer* veins, and probably are.

On the lower vein several open-cuts have been made which show a well-defined vein from 12 to 18 inches wide. A sample taken across 16 inches returned on assay: Gold, 0.58 oz.; silver, 2.2 oz.; copper, trace.

On the central vein considerable work has been done, consisting of several large open-cuts and two shafts about 20 feet deep. This vein is from 2 to 4 feet wide and somewhat oxidized on the surface. In a cut at an elevation of 4,500 feet the vein is 4 feet wide, of which 2 feet is mineralized; a sample taken across this mineralized portion assayed: Gold, 0.74 oz.; silver, 1.8 oz.; copper, trace.

At an elevation of 4,600 feet an open-cut shows a strong well-mineralized vein. A sample across 12 inches at this place returned the following results: Gold, 3.34 oz.; silver, 6.4 oz.; copper, 0.4 per cent.

The upper vein has not as much work done on it as the other two veins. It is very similar to the upper vein as found on the *La Petite Fraction*, in that it is about the same size and it is split, the offshoot going off to the west, at practically the same strike and dip. At elevation 4,550 feet a 10-foot shaft is sunk on the vein.

A sample taken across 18 inches of the vein gave the following results: Gold, 0.18 *oz.*; silver, 1.2 *oz.*; copper, 0.3 *per cent.*

Gold Crown. This claim, owned by E. Hoops, is situated on the eastern side of the mountain and lying to the south-east of the *Pioneer group. There are three veins showing on this claim, only two of* which were sampled. At an elevation of 4,805 feet an open-cut shows a vein 2 feet wide, apparently on the same strike as the upper vein of the *Pioneer* group, and having, where exposed, a strike of N. 70° W. A sample taken across the full width of vein in this cut returned on assay: Gold, trace; silver, 0.8 oz.; copper, trace.

About 300 feet to the north-east of this open-cut a vein is uncovered at an elevation of 4,790 feet; this vein is close to where the extension of the centre vein of the *Pioneer* group should be, and where shown has a strike of S. 80° W. and stands vertical. A sample taken across 26 inches of the vein here assayed: Gold, 0.56 oz.; silver, 1.5 oz.; copper, 0.5 per cent.

It is very probable that the three veins of the *Pioneer* group are the veins of the *Gold Crown*, *La Petite*, and *North Star* groups, as the veins are in the proper place and have the same appearance and characteristics as well; this would show them to be very strong, persistent veins.

For convenience the following tabulated list of the assays of samples taken from the claims is inserted:—

Name of Claim.	Description of Sample.	Gold.	Silver.	Copper.
		Oz.	Oz.	Per Cent.
Bullion group	Across 33 inches	0.48	2.0	Trace.
"	" 30 "	0.76	4.6	"
Lucky Boy	" 18 "	0.60	3.6	1.9
Snowflake	" 24 "	2.70	19.7	0.8
Mohawk	" 6 "	0.46	3.3	Trace.
"	From 8-inch vein	0.36	25.4	"
Silver Fox	Across 20 inches	0.56	15.0	1.2
Pioneer	" 18 "	0.36	1.6	Trace.
La Petite	" 16 "	6.56	10.2	2.0
" (lower vein)	" 14 "	1.26	4 4	Trace.
North Star	" 16 "	0.58	2.2	"
Gold Seal	" 24 "	0.74	1.8	"
"	" 12 "	3.34	6.4	0.4
North Star group (upper vein)	" 18 "	0.18	1.2	0.3
Gold Crown	" 24 "	Trace.	0.8	Trace.
"	" 26 "	0.56	1.5	0.5

The general average of these samples is good, and while too much reliance should not be placed on them, they at least show that there is some gold-bearing quartz in the camp of a commercial grade. Gold ores are, as a rule, very pockety, and many samples must be taken before an approximation of average values can be obtained.

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