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CANADA
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BUREAU OF ECONOMIC GEOLOGY
GEOLOGICAL SURVEY

MEMOIR 181

Barkerville Gold Belt, Cariboo District, British Columbia

BY

G. Hanson

PETROLOGICAL SCIENCES DIVISION

OTTAWA
J. O. PATENAUDE, I.S.O.
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1935

Price, 25 cents No 2396

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CONTENTS

	Page
Introduction	1
Regional geology	1
Geology of the Barkerville gold belt	3
Structure of the gold belt	7
Mineral deposits	9
Origin of the deposits	14
Résumé and possibilities	16
Mines and prospects	19
Addenda	34
Index	41

Illustrations

Map 2394. Barkerville gold belt, Cariboo district, B.C. (North portion)..In pocket

Map 2395. Barkerville gold belt, Cariboo district, B.C. (South portion)..In pocket

Figure. 1.	Island Mountain Mines, Limited, main adit	21
2.	Island Mountain Mines, Limited, vertical section	21
3.	Cariboo Gold Quartz mine, 1,500 adit	22
4.	Cariboo Gold Quartz mine, vertical section	22

Barkerville Gold Belt, Cariboo District, B.C.

INTRODUCTION

The writer commenced, in 1933, geological mapping and investigation of the lode gold resources in Willow River map-area, Cariboo district. In 1934 this work was continued, but special attention was paid to the lode deposits in the map-area and in adjacent ground with the hope that information would be obtained that would be of practical value in mine development and in searching for deposits. It was found that most of the main known deposits lay in a long, narrow strip of country, and this strip, here called the Barkerville gold belt, was examined in detail and its description will form the subject matter of this report.

The existence of a belt of rocks that is characterized by the presence of gold-bearing quartz veins, and that is a distinct feature in a district of scattered gold deposits, has been known for many years. The boundaries of the belt have not been drawn previously nor has any explanation been given of the presence of the belt. Bowman stated that profitable gold-bearing veins were confined to the Cariboo series, and noted as well that there was a striking alinement of deposits from Lowhee creek southeastward to Grouse creek.[1] Uglow divided the veins of Barkerville district into two classes, A veins which are roughly parallel to the strike of the rocks and B veins which are transverse to the strata. He also stated that the A veins occur in a belt ¼ mile to 3 miles wide extending from Round Top mountain northwestward to Sugar creek, a distance of 26 miles.[2] Lay directed attention to the mineral belt near Barkerville, which he calls the Barkerville belt, and pointed out that it is both a gold placer and a vein belt.[3] The deposits of the belt proved to be very closely related to the bedrock geology and it is desirable to present first a summary of the geology of the district so that the reader will be able to understand more easily the mode of occurrence of the mineral deposits.

REGIONAL GEOLOGY

The oldest rocks of Cariboo district are known as the Cariboo series. The rocks are not fossiliferous, but from their structural position, degree of metamorphism, and their similarity to Precambrian rocks farther south, they are believed to be of Precambrian age. They consist of quartzites, argillites, and limestones slightly to strongly sheared and having a total thickness of many thousand feet. The series has been folded into a northwesterly trending anticline. The medial part of the anticline is exposed

[1] Geol. Surv., Canada, Rept. Prog. 1870-1877, pp. 26, 28.
[2] Geol. Surv., Canada, Mem. 147, pp. 187-191 (1926).
[3] B.C. Dept. of Mines, Bull. No. 1, 1932, pp. 46-48.

for a width of 15 miles and a length of more than 50 miles. Only 50 miles of the anticline has been mapped so the total length is not known. Intruding the Cariboo series are a few dykes and sills of quartz porphyry and allied acidic rock types. They are called the Proserpine intrusives and are believed to be pre-Mississippian and possibly Precambrian in age. Unconformably overlying the northeastern limb of the anticline is the Slide Mountain series of Upper Palæozoic age, consisting from bottom to top of conglomerate, crinoidal limestone, banded chert, argillite, and basaltic lavas. The upper part of the series is cut by many gabbroic dykes. The series dips northeast. Overlying the southwestern limb of the anticline, also unconformably, are Jurassic argillites and basalts called the Quesnel River group. The sediments of the group dip southwest.

CABIBOO SERIES

The Cariboo series is of special interest for in it are all the known lode gold deposits of the district. In Barkerville map-area the series has been divided into three formations.[1]

Pleasant Valley formation
Barkerville formation
Richfield formation

The Richfield formation, the lowest exposed formation of the Cariboo series, consists mainly of quartzite, but includes as well limestone, black argillite, and other rock types gradational between the three named. The members of the formation do not extend far as distinct lithological units, but change gradually along the strike and dip from quartzite to argillite or to limestone and from argillite to limestone. In the vicinity of Barkerville, however, the lower half of the formation is mainly quartzite. Above this are several members of black argillite separated by quartzite members, several of which contain thin beds of limestone. The uppermost part of the formation consists of limy quartzite becoming more limy towards the top. The Barkerville formation overlies the Richfield formation conformably and consists mainly of bluish grey limestone, commonly in beds 20 feet or more thick, black argillite, commonly limy, and quartzite. The Pleasant Valley formation overlies the Barkerville formation and consists mainly of black argillite.

The rocks of the series have yielded in a varying degree to shearing stresses, so that although the general nature of the original rock is rarely in doubt the bedding in some places has been obscured, and the strength of the rocks has been changed. Some quartzite members several hundred feet thick show signs of shearing only along bedding planes. Other quartzite beds have been changed to sericite schists and quartz-sericite schists. Thick beds of argillite are in general only slightly sheared, but locally argillite has been changed to graphitic schist. Limestone has become marble. Beds of schistose rocks containing many scattered crystals of ankerite, and locally quite fissile, are common, and have been formed

[1] Johnston, W. A., and Uglow, W. L.: "Placer and Vein Gold Deposits of the Barkerville District, B.C."; Geol. Surv., Canada, Mem. 147 (1926).

from quartzites and argillites that contained, perhaps, calcareous matter. The shear planes coincide practically with the strike of the rocks, but they tend to cross minor folds and rolls at an angle to the dip of the strata.

The crest of the anticline, the structural form in which the series occurs, is approximately horizontal near Barkerville pitching locally 5 to 10 degrees. To the northwest in Willow River map-area the crest pitches northwest, the angle of pitch steepening to 45 degrees. On the whole the anticline is simple and the limbs have moderate dips. Minor longitudinal folds occur on the limbs but are of small size. In general the tendency to minor folds is exemplified only by small changes in dip and strike. For example, on the northeastern limb the northeasterly dip of the strata is about 45 degrees and the strike is southeast, but locally the dip flattens to 10 degrees for a dip length of 100 feet or less and then swings back to 45 degrees, and locally also the strike swings as much as 30 degrees from the usual direction of strike.

The Cariboo series and Slide Mountain series are cut by northeasterly striking normal faults. There are two other sets of normal faults in the Cariboo series that may or may not cut the Slide Mountain series. One set strikes north and the other northwest.

GEOLOGY OF THE BARKERVILLE GOLD BELT

The upper part of the Richfield formation in the vicinity of Barkerville is cut by a multitude of quartz veins, many of which are gold bearing. The part of the formation characterized by the numerous quartz veins is called the Barkerville Gold Belt and in general underlies an area less than a mile wide and at least 10 miles long. There are quartz veins elsewhere in Cariboo district and many are gold bearing, but they cannot yet be grouped into well-defined belts. Although the belt was examined in considerable detail, outcrops of bedrock were so infrequent that correlation of lithological members and individual beds was uncertain in many places. However, excellent exposures along the west side of Jack of Clubs lake, along Lowhee creek, Stouts gulch, and Williams creek, together with underground and surface openings made by mining companies and prospectors, provided enough information for satisfactorily mapping the northwestern half of the belt and for more general mapping of the southeastern half.

No base map was available for detailed mapping of the belt so for that purpose a map was compiled from various mineral claims maps, and geological features were located with reference to claim posts. A similar plan had been started the preceding year by Dr. Smitheringale of Island Mountain Gold Mines, Limited, but had not been finished. The writer had access to this partial mineral claims compilation and found it very useful.

Only that part of the Barkerville gold belt extending from Island mountain southeastward to Grouse creek has been mapped geologically and only this part will be described in detail. Bedrock exposures are very infrequent on the northwestern part of Island mountain and beyond that place the position of the northwestern continuation of the belt is uncertain. Uglow has mapped a northeasterly striking fault passing along the northwestern side of Island mountain and the strata on the northwest side of the fault are represented as having a horizontal displacement to the

southwest of 4 miles.[1] The gold belt is possibly offset an equal distance and if so it should continue northwestward near Willow river, perhaps crossing Montgomery and Dragon creeks. In view of the fact, however, that the structure of the rocks in which the gold belt occurs changes to the northwest into a northwesterly plunging anticline, the gold belt itself may not extend far and if it should continue for 5 or 6 miles it would probably in this distance swing from a northwesterly trend to a westerly trend in conformity with the change in strike of the strata.

From Island mountain southeastward to Grouse creek, a distance of 8 miles, the belt is fairly clearly defined and correlations within the belt are satisfactory. From Grouse creek southeastward to Antler creek, a distance of 4 miles, correlations within the belt are unsatisfactory, the belt itself appears to swing more to the south, seems less clearly defined, and may be losing its identity. Southeast of Antler creek less is known about the belt. The mineral deposits there appear to be spread over a broader area.

The rocks of the gold belt have been subdivided into five members, listed below:

Baker member, mainly fissile, grey, calcareous quartzite
Rainbow member, partly fissile, interbedded argillite and quartzite
B.C. member, black argillite
Lowhee member, mainly fissile, grey quartzite
Basal member, black argillite

Between Island mountain and Grouse creek the uppermost part of the Richfield formation, named the Baker member, consists mainly of grey, calcareous sediments, in general quite soft and sheared so that the rock is fissile. Much of the rock is sericite schist, many specimens of which contain enough calcite to effervesce when dilute hydrochloric acid is applied. The rocks are mainly if not entirely fine grained. A few bands contain argillaceous matter and are dark grey to black in colour. The member contains a few discontinuous beds of limestone, one of which near the base of the member at the Island Mountain mine holds a valuable orebody of replacement type.

The member occupies a belt approximately 1,500 feet wide and is about 1,000 feet thick in the northwestern part of the gold belt, whereas at Grouse creek the width is more than 2,000 feet and the thickness about 1,500 feet. Northwest of Barkerville the dips of the strata within the Baker member range from 20 to 60 degrees and average about 40 degrees. Southeast of Barkerville they are steeper and average 50 or 60 degrees. Southeast of Barkerville the outcrop of the member may have been widened by duplication of strata caused by minor folding. The member is cut by a few quartz veins, but veins are uncommon compared with the numbers occurring in underlying strata.

Northeast of this member is the overlying Barkerville formation, the basal beds of which are massive, grey to bluish grey limestone.

The ore-bearing bed of limestone at the Island Mountain mine is in general less than 10 feet thick, but locally, combined with very limy sediments, is 50 feet thick. The bed cannot be certainly correlated with limestone beds southeast of Jack of Clubs lake, but at the Cariboo Gold Quartz mine near the portal of the 1,500 adit a limestone bed occupies approxi-

[1] Johnston, W. A., and Uglow, W. L.: Geol. Surv., Canada, Mem. 147 (1926).

mately the same stratigraphic horizon. At the Island Mountain mine the bed is about 600 feet structurally higher than a persistent band of argillite, whereas the limestone at the Cariboo Gold Quartz mine is less than 500 feet structurally higher than the same band of argillite. This suggests that unless the limestone beds are at the same horizon, the one at Island mountain is structurally higher.

The lower part of the Baker member is penetrated by the underground workings of the Island Mountain mine and of the Cariboo Gold Quartz mine. Occasional outcrops expose the member northwest of Jack of Clubs lake, on lower Lowhee creek, and about 2 miles southeast in the B.C. ditch. The upper part is apparently cut by the Shamrock tunnel. The member outcrops again on the Conklin mineral claim, at the head of Conklin gulch, and on Grouse creek below the Kumangetit fraction claim. In some places outcrops are continuous across the width of the member to the overlying Barkerville formation and although along the strike long gaps exist between outcrops the mapping of the member is believed to be correct.

Below the Baker member is a series of interbedded quartzites and argillites called the Rainbow member. This member is cut by thousands of quartz veins and it with the lower part of the Baker member constitutes the most valuable part of the Barkerville gold belt. In the Island Mountain and Cariboo Gold Quartz mines the beds of the Rainbow member form a zone approximately 900 feet wide across the strike and are probably between 500 and 600 feet thick. Beds or other small lithogical units within this member can be traced for very short distances only. Because of persistent members below and above, however, the member can be followed with some assurance from Island mountain southeastward to Barkerville, and with less assurance to Grouse creek. The breadth of outcrop appears to be much greater at Grouse creek and may exceed 1,500 feet.

At the Island Mountain mine the beds are much shattered and apparently rather intricately folded. They consist of argillites with some quartzites, and a few thin beds of limestone. Some beds of clastic sediments are quite limy. The clastic sediments are sheared so that locally they are fissile. The member could not be subdivided into divisions traceable throughout the mine workings.

In the Cariboo Gold Quartz mine the member was subdivided into four units. The uppermost or No. 1 unit is about 300 feet wide across the strike and consists of interbedded black argillites, argillaceous quartzites, and grey quartzites, all somewhat sheared. The next or No. 2 unit is 100 feet to 200 feet wide and consists of grey quartzite, locally schistose, and a thin bed of limy quartzite. Below this No. 3 unit is 200 to 300 feet wide and consists of interbedded grey quartzites and black argillites all somewhat sheared, and a few thin beds of impure limestone. No. 4 unit at the base of the Rainbow member is 100 to 200 feet wide, consists of fine-grained, grey quartzites, somewhat sheared and fissile, and a thin bed of impure limestone. Attempts to trace the beds, a few feet thick, of quartzite or of argillite throughout the workings of the Cariboo Gold Quartz mine failed, but showed that such beds change rapidly in their nature along the strike and dip. Several examples showed a change from northwest to southeast, from argillite to argillaceous quartzite, and finally to grey quartzite. No

examples showed similar changes in the opposite direction and the suggestion is that the sediments came from the southeast. Limestone and limy beds proved more persistent than beds of clastic sediments.

Farther southeast on the Myrtle claim, the beds are subdivided, in part, into argillites and dark quartzites. The beds cross the Marie, Martha, Morning Star, and Evening Star claims but could not be subdivided. The rocks exposed there are argillite and quartzite and on the Evening Star there is near the top of the member a bed of limy sediments about 50 feet thick. The beds cross Williams creek at the mouth of Stouts gulch and consist of interbedded quartzites and argillites with some limestone near the top of the member. The beds cross the Freegold, Wilkinson, Proserpine, Proserpine East, Penelope, Warspite, Tipperary, Kitchener, Independence, and Hard Cash claims, but could be subdivided only in the area between the Warspite and Hard Cash claims. The rocks consist there of argillaceous quartzite units separated by grey quartzite units, but the member could not be separated from very similar underlying sediments of the Lowhee member.

The rocks of the Rainbow member are sheared to some extent everywhere, but only locally are they severely sheared. The beds dip 10 to 70 degrees northeast and the shearing is practically parallel to the bedding. In general, argillaceous divisions show greater fissility due to shearing than quartzite divisions. The limy grey rocks vary considerably in fissility, some bands are very soft and only slightly fissile and were presumably limy oozes, other bands are soft and fissile and were originally soft, fine-grained, clastic sediments. The purer limestone beds are not fissile.

Under the Rainbow member is a series of black argillites called the B.C. member. The base of the member is not exposed on Island mountain but the breadth of outcrop there is at least 800 feet. Southeast on Cariboo Gold Quartz ground this member where exposed in the Lowhee ditch is also 800 feet wide, but farther southeast it narrows and may change gradually to quartzite. It has not been identified southeast of the B.C. vein on the Cariboo claim, but may extend as far as the Morning Star claim. The member consists almost entirely of black argillite and served as a very useful horizon marker, for it could be traced with assurance from Island mountain to the Cariboo claim. The rocks are only slightly sheared, perhaps because compared with the overlying interbedded Rainbow member they were a thick homogeneous unit. The member is not known to contain quartz veins of value where it is thick, but where it becomes thinner, as at the Cariboo claim, it contains well-mineralized veins. Compared with the Rainbow beds the member contains very few quartz veins.

Under the B.C. member is a series of quartzite and other fine-grained, grey, clastic sediments named the Lowhee member. This member pinches out or changes to argillite northwest of the Lowhee ditch and widens to the southeast until on Lowhee creek it is over 2,000 feet wide. Southeast of the Morning Star claim it adjoins and merges with the overlying Rainbow member and the two extend to Grouse creek where the combined bands are 3,500 feet wide. The rocks of the Lowhee member are quartzites and argillaceous quartzites. Argillite and limestone are rare or absent. A thin bed of coarse, angular, clastic material outcropping on the Mucho Oro claim may be tuffaceous in origin. The rocks have been sheared to a vary-

ing degree, some are fissile, but near Grouse creek the rocks are in general massive and only slightly sheared. Where the Lowhee and the Rainbow members adjoin they cannot be separated from each other as the rocks of both are much alike. The member contains many quartz veins, but it has not been explored underground, and very little is known about the persistence and value of the veins. In general it seems that the veins are leaner than those in the Rainbow member.

Under the Lowhee member is a thick series of black argillites called the Basal member. Northwest of the Lowhee ditch the Basal and B.C. members adjoin, and make up a band of argillite 2,500 feet wide. West of the Lowhee Creek-Stouts Gulch divide the member is 800 to 1,000 feet wide. It is wide along Williams creek between McCallum gulch and Richfield and then narrows rapidly to the southeast and reaches Grouse creek at the mouth of Downie creek as a band only 100 feet wide. The rocks of the member are black argillite only slightly sheared. The member contains quartz veins of good size but which appear to be very lean. Under the Basal member are quartzites, argillites, and other similar clastic sediments containing large, apparently barren or very lean quartz veins.

The Baker member caps the gold belt on the northeast and the Basal member forms the base on the southwest. Gold seems in general to be concentrated toward the northeast side of the belt.

STRUCTURE OF THE GOLD BELT

The gold belt rocks are on the northeastern limb of a large northwesterly trending anticline. The rocks strike northwest and dip northeast. In the main the folding within the belt seems simple, but in some places minor folds were seen where the dip changed from 45 degrees to horizontal and back to 45 degrees in a breadth of outcrop of 5 to 50 feet. Fissility induced by shearing stresses obscures the bedding in many places, however, and minor folds may be fairly common. In view of this, and although the structure is believed to be simple because the rocks probably all dip northeast, an alternative interpretation of the structure is given for part of the belt. This interpretation is based not on observed strikes and dips but on the mapping of rock types traceable for some distance along the belt.

The Lowhee member ends abruptly northwestward at the Lowhee ditch and widens rapidly southeastward to Lowhee creek. If this member lay in the trough of a southeasterly pitching minor syncline the areal distribution of the rocks would be explained very well. Northwest of the Lowhee ditch the member would be absent because it was eroded, and to the southeast the breadth of the Lowhee member would become greater because of the synclinal pitch in that direction. The B.C. argillite member would then be at the crest of a sharp anticline, and would be the same argillite band as that called the Basal member. The Lowhee member would overlie it and would be a correlative of the Rainbow member. This interpretation of the structure would account for the similarity displayed by the Basal and B.C. members, and by the Lowhee and Rainbow members, and would also explain the areal distribution of the Lowhee member.

The dips of the strata do not support this interpretation. As more underground exploration is done, more will be learned of the true dips of the sediments, and the structure will become easier to decipher.

The rocks of the gold belt are traversed by a great many pre-mineral fractures, many of which are occupied by quartz veins. The fractures are relatively most plentiful in the Rainbow member. Most of the fractures cut the strata at, roughly, right angles and their strikes range from north 15 to 60 degrees east. Another set of fractures cross the strike of the beds diagonally and strike from north 60 degrees east to east. Others are approximately parallel to the strata. Many of the fractures at right angles to the strike of the strata contain no quartz, many hold quartz veins a fraction of an inch to several feet wide. All the fractures diagonally crossing the strata and so far as is known also all those that parallel the strata contain quartz veins. The transverse and diagonal fractures are not faults. Those roughly paralleling the strata are faults. The transverse and diagonal fractures show marked relationships to the rocks traversed and these and other premineral fractures will be discussed fully under types of mineral deposits.

A number of post-mineral faults occur in the gold belt. Some of these show considerable displacement, but most are small. The faults appear to belong to different systems and were not all formed at the same time.

Faults of small displacement occur on one wall of some of the diagonal veins. Locally these are called diagonal faults and appear to be the earliest of the post-vein faults. Only a few such faults were seen and in no case was the displacement measured. There is some crushed rock, however, between the fracture walls, showing that there was some displacement. It would seem that the more persistent diagonal veins were the loci of early post-vein movement of slight magnitude. In the Cariboo Gold Quartz mine one of the diagonal faults is offset by a strike fault.

Several northerly striking faults that have offset the strata 1,200 feet or less horizontally cross the gold belt. These faults dip about 60 degrees east and in all cases the strata on the east side have been displaced to the south. Four main faults of this type were recognized: the Rainbow fault on which the strata are offset 400 feet, the Lowhee fault on which the strata are offset about 1,200 feet, the Grouse fault on which the strata are offset about 900 feet, and the Island Mountain fault encountered in the workings of the Island Mountain mine and on which the offset has not been measured or estimated, but which appears to be of smaller magnitude than the others.

The Rainbow fault is crossed by the workings of the Cariboo Gold Quartz mine and is better exposed than the others. It offsets veins and locally also contains pieces of drag ore. These faults wherever they could be studied are zones of broken rock 100 feet or so wide in which there is one main locus of movement, a fault several feet wide, filled with gouge and less finely crushed rock. The faults appear to branch but the branches were not traced fully enough to demonstrate the exact fault pattern. The faults may have been caused by settling, but the movement was not directly downward along the dip but had also a component along the strike.

Strike faults are the commonest type in the belt. These parallel the strike and dip of the strata and are of the normal type, but in some there was also some movement along the direction of strike. Faults of this type do not follow the bedding around sharp curves in strike and dip but cross-cut such places at a low angle. The throw on these faults is less than 25 feet and on many is less than 6 feet. In general such a fault with a throw of only 20 feet has much crushed rock in it and the rock where not crushed is drag-folded. Some have branch faults that may swing to a widely different strike before they end. The lengths of the strike faults have not been measured but some are at least 500 feet long. The strike faults may be related to those striking north but a relationship has not been proved. A branch of a northerly striking fault may curve to parallel the beds but the strike faults may not all be branches of the larger northerly striking ones. The strike faults appear to be late and may be younger than those striking north.

Uglow has mapped a set of northeasterly striking and northwesterly dipping normal faults that are younger than the late Palæozoic rocks of the area, but none of these faults was recognized with certainty in the gold belt. Faults striking northeast are crossed by the Shamrock tunnel near Barkerville, but the displacement could not be ascertained.

MINERAL DEPOSITS

The mineral deposits of the belt consist of quartz veins and of pyritic replacements. Many of the quartz veins contain much pyrite and are of value because of their gold content. The replacement deposits consist of pyrite and are also valuable because of their gold content.

Veins. A great many of the pre-mineral fractures are occupied by veins. The veins and also the unmineralized pre-mineral fractures are strikingly related to the rocks and to the geological structure. An understanding of this relationship has a vital bearing on the problems of mine development and search for ore-bodies.

The different rock types reacted differently under stresses causing fracturing. Limestone is cut only by the stronger fractures. The limy clastic sediments did not fracture readily. The argillites where not severely sheared fractured well. Quartzites also fractured readily, but argillaceous quartzites appear to have been the most favourable rock for fractures. The degree of fissility induced by shearing stresses also influenced fracturing. Some very fissile, fine-grained quartzites have many joint cracks, some occupied by narrow veins, whereas quartzites only slightly sheared have fewer but more persistent fractures. Fractures are rare in argillaceous rocks that have been sheared to graphite schists, but slight shearing appears to have rendered argillites more amenable to fracturing.

A characteristic of most of the transverse fractures and veins is that they do not continue across rocks of dissimilar type. If a fracture is strong in an argillaceous rock it fades out rapidly in adjoining quartzite, and if another is strong in quartzite it dies out rapidly in adjoining argillites. But sections consisting of argillites and quartzite interbedded in thin beds act as a unit and fractures may persist through.

The Baker member is a fairly homogeneous unit consisting mainly of fissile calcareous quartzites containing relatively few veins. The Rainbow member consists of several rock units. Veins are very numerous but do not cross the whole member and rarely cross more than one unit. The B.C. member is a homogeneous, unsheared unit. It contains relatively few veins, but those that do occur appear to be more persistent than those in the Rainbow member. The Lowhee member is locally quite schistose. It has many veins but few compared with the Rainbow member. The veins have about the same persistence as those of the Rainbow member and careful examination might show that they terminated in less favourable rock bands. The Basal member is homogeneous and unsheared. Very few veins were seen in this member but they appeared to be quite persistent.

The reason for the occurrence of veins in one rock type and not in an adjacent rock of different type has not been established, but the probable reason is that one rock failed under stress by fracturing whereas the other failed by bending or flowing. It is assumed that when the fracture-forming stresses acted on the district the rocks of the Baker member yielded by bending and flowing rather than by fracturing, those of the Rainbow and Lowhee yielded by fracturing rather than by bending, and those in the B.C. and Basal members yielded only to a slight extent and only by fracturing.

At the Island Mountain mine the transverse veins strike 30 to 45 degrees and dip approximately 70 degrees southeast. At the Cariboo Gold Quartz mine they strike 30 to 55 degrees, but the dip is vertical, steep to the southeast, or steep to the northwest. Near Barkerville the prevailing strike of the transverse veins is 15 to 30 degrees and the dips appear to be mainly steep to the northwest. Near Grouse creek the prevailing strikes appear to be 25 to 35 degrees and the dip approximately vertical or steep to the southeast. Transverse fractures are very numerous. Many appear to be joints and in some places are so closely spaced as to resemble fracture cleavage, but in general they are too far apart to be mistaken for fracture cleavage cracks. Commonly fissile rocks traversed by these fractures show an abrupt flexure parallel to the fracture and on both sides of it. In the Cariboo Gold Quartz mine most of such flexures show a downward bend or a convexity downward on the northwest side of the fractures and an upward bend or a convexity upward on the southeast side. The flexures are approximately at right angles to the fissility and strike of the rocks, their lengths are in most cases less than 100 feet and perhaps less than 50 feet, and their widths 8 inches or less. It would seem that the flexures were formed by compressive stresses acting parallel to the main structure and that either while they were being formed, or afterwards, the flexures broke along a medial line forming the fractures. A peculiarity of some of the transverse veins occupying a medial fracture along a flexure is that they have short, narrow, wedge-shaped branches that leave the veins at angles of about 30 degrees and penetrate the flexures from their convex sides. These little wedges of quartz are in general less than 1 foot long and 2 inches wide and commonly are only 6 inches long and 1 inch or less wide at the base. Exceptionally they are several feet long and have a more uniform width of 1 inch or less. Such branches suggest strongly that the flexure had been formed prior to the deposition of the quartz veins.

Many of the transverse fractures contain quartz veins. In general each such vein is of uniform thickness through most of its length. It may end as a single tapering vein or as a fan of divergent narrow branches. Some are distinctly lenticular, the central part being the widest. Transverse veins are in general less than 4 feet wide and less than 200 feet long. A few are locally as much as 5 feet wide.

All the diagonal fractures are quartz filled. In the main they strike north 70 degrees east to east. They dip southeast to south in the Island Mountain mine and are approximately vertical in the Cariboo Gold Quartz mine, and in this respect behave much like the transverse veins. Diagonal veins are not so plentiful as transverse veins. In the Cariboo Gold Quartz mine, for example, there are about five times as many veins of the transverse type as of the diagonal type. Diagonal veins do not display the regular, closely spaced mode of occurrence exhibited by the transverse veins but are, on the average, broader and longer. In the Cariboo Gold Quartz mine, for example, one-third of the larger veins and only about one-sixth of the smaller ones are of the diagonal type. Diagonal fractures cut through rocks of dissimilar nature more commonly than those of transverse type. The longest diagonal vein found so far at the Cariboo Gold Quartz mine is 300 feet long. It is 5 feet wide at the widest place.

What may be considered another type of fracture is one very closely associated with the two types previously discussed. These are branch fractures and are filled with branch veins. Branch veins from diagonal veins are broader and longer than those from transverse veins. Some branches from transverse veins swing back to the vein in a few feet to form links enclosing horses of country rock. Others diverge at various angles and in general wedge out quickly. Some transverse veins appear to be branches of diagonal veins. Many diagonal vein branches, however, occupy curving fractures and die out quickly as irregular tapering wedges.

At the Cariboo Gold Quartz mine the transverse and diagonal veins occur to some extent in zones each of which may contain half a dozen or more fairly closely spaced veins. The Sanders vein zone in the mine is a transverse zone and apparently crosses through the whole width of the Rainbow member. Individual veins in the zone, however, do not continue the whole length of the zone. Where this zone crosses the Rainbow member the latter is divisible into four units and although the vein zone crosses all the units, individual veins rarely extend through more than one unit.

Another type of quartz-filled fracture is one that closely parallels the strike and dip of the strata. An excellent example is furnished by the B.C. vein exposed on the Cariboo claim. At that place the vein has filled and replaced a fault and associated crushed zone. The vein-filled fracture clearly crosscuts the strike of the strata at a small angle and is a few degrees steeper than the dip of the strata. Very few vein-filled fractures of this type were seen and in general exposures were inadequate for detailed examination. The B.C. vein is 20 feet wide. There are also several large and small veins, usually of lenticular shape, paralleling the strata and possibly in some cases the fissility of the rocks. In most of these cases the rocks have not been disturbed, as they probably would have been if there had been any pre-vein fault. The lensy bed veins do not appear to

have the persistence of those occupying faults approximately paralleling the beds, for although the lenses are locally more than 20 feet wide they pinch out quickly or split up into several veins.

Since any individual vein tends to be confined to a rock type and does not, as a general rule, strike across several rock types, it is reasonable to conclude that down the dip the vein will also remain within the same rock type. The vein will, therefore, pitch along the dip of the strata and will be found not vertically above or below where it was discovered, but above or below along the direction of dip of the rock. Any vein of the diagonal or transverse type if it bottoms on an unfavourable rock member will ordinarily bottom along the plane marking the junction of the host rock and the unfavourable rock.

Mining has not yet gone far enough to prove this rule, but if the rule should be proved it will be obvious that veins may follow a favourable member down the dip until the structure or rock type becomes unfavourable or until a point is reached where fracturing was inadequate. The best hope for deep mining would appear to depend on the belief that adequate fractures will occur in the favourable members a considerable distance down the dip. Because the favourable part of the gold belt contains numerous veins over such a great length and at considerable differences of elevation there seems to be little doubt that the vein fractures are very closely related to the general structure and will follow the favourable rocks down the dip to where, for reasons not yet apparent, they become inadequate as loci for commercial ore-bodies.

The vein deposits can be divided into four classes, the division being based on the relationship between the fractures and the structure of the country rock:

(1) Transverse veins
(2) Diagonal veins
(3) Strike fault veins
(4) Bed veins

The transverse and diagonal veins contain pyrite and arsenopyrite, and many have small amounts of gold, galena, sphalerite, bismuth-lead sulphide, marcasite, telluride, and scheelite, in a gangue of quartz, commonly with some ankerite, less sericite, and very rarely calcite. In some veins pyrite approximates 50 per cent of the vein by volume, but in most veins the quantity of pyrite is smaller. Gold appears to be most plentiful in the veins containing the most pyrite, but the amounts of the two minerals are not in direct proportion. Veins with very little pyrite are in general uncommercial, but those with 50 per cent pyrite are not all richer than those with 25 per cent pyrite. Arsenopyrite occurs with the pyrite in most of the veins, but is always a minor constituent. Galena is rare except in a few veins, mainly in the southern part of the belt. Scheelite is present in small quantities in many veins throughout the belt and appears to be most plentiful in the northwestern part. Sphalerite and marcasite occur locally in a few veins. The lead-bismuth sulphide occurs in nests in many veins, but is rare. Telluride occurs in very small quantity associated with the lead-bismuth sulphide.

A characteristic of the transverse and diagonal veins is the coarseness of the pyrite crystals. Typically, the pyrite is in cubes 1 inch or

less to the side. The quartz is also coarsely crystalline in some veins, but in general it does not show crystal outlines so that the size of crystal cannot be seen. Ankerite is fairly common in many veins, particularly along the walls. Some of the narrow veins, a few inches wide, have about 20 per cent ankerite by volume, and branches of the veins appear to contain more ankerite than the parent veins. Many veins have little or no ankerite and those containing much ankerite have in general very little gold. Calcite was seen in veins only where they cut beds of limestone. Thin foils of sericite occur in some veins. Those containing much sericite have very little gold. Gold occurs free throughout the veins, but is especially abundant in the nests of the lead-bismuth sulphides. It varies greatly in fineness. Pieces weighing $\frac{1}{4}$ ounce have been found and specks $\frac{1}{10,000}$ inch in diameter have been seen microscopically.

Another characteristic of the veins is that they have been shattered so much that it is difficult to obtain large solid hand specimens. In mining, veins break up into small pieces.

The strike fault veins are not numerous and are poorly exposed. Only one such vein, the B.C. vein, was seen underground. It contains pyrite in quartz and in mineralization appeared to be like scores of transverse or diagonal veins. The B.C. vein, so far as known, has much lower values in gold than the normal pyritic transverse or diagonal veins, but it is not located in the richest part of the gold belt and, therefore, should normally have a low gold content. Veins of this type have not been developed sufficiently to prove that they are of low grade or to prove that they are uncommercial.

Only a few bed veins were seen, some of these are quite thin and short, but most are wide lenticular bodies. These in general consist of quartz with no pyrite and no gold. Development work done on veins of this type is too meagre to give a reliable picture of their value. Some have been deformed with the adjoining rock and, therefore, appear to be earlier than the transverse and diagonal veins. Some small bed veins join with transverse veins and appear to be of the same age and are mineralized in the same way.

Uglow divided the veins into A and B veins and stated that the B veins were higher grade than the A veins. The B veins would include the transverse and presumably also the diagonal veins. The A veins would include the strike fault veins and the bed veins. Many of the large A veins lie outside of the gold belt and are not well mineralized, but scant mineralization also characterizes many veins truncating the strata at various angles outside of the gold belt. The writer feels that so far as the gold belt is concerned there is not enough data to classify the veins paralleling or nearly paralleling the strata as being uncommercial.

REPLACEMENT DEPOSITS

The other main type of deposit is one formed by replacement of limestone. This type of deposit was discovered in the Cariboo in 1933. The largest so far found is in the Island Mountain mine. The ore of this type is in general higher grade than the vein ore and commonly assays 2 ounces

of gold a ton. The best ore consists of massive, fine-grained pyrite with free gold. Rarely the ore contains small nests of scheelite and specimens have been found containing small amounts of chalcopyrite and galena. The fine-grained nature of the ore is in marked contrast with the coarse pyrite of the veins. Where replacement is less intense the ore consists of silicified limestone with streaks of minute pyrite crystals and local bunches of ankerite or dolomite. Some impure, shaly, limy bands at the ends or edges of the ore-body are replaced by coarse pyrite crystals. The ore-body at Island mountain is at least 300 feet long and in one or two places is 9 feet wide. It extends for about 300 feet up the dip above the main tunnel. Its downward extent has not yet been determined. It is not so irregular in shape as might be expected of limestone replacement bodies, probably for the reason that the limestone occurs in uniform narrow beds. Several bodies of this type are exposed in the workings of the Cariboo Gold Quartz mine. The largest body so far found there has a maximum thickness of 18 inches. The grade and general appearance are identical with the ore in the Island Mountain mine. At the Cariboo Gold Quartz mine the limestone appears to have been more silicified than at Island mountain and a few limestone beds have been changed into quartz beds. None of the siliceous replacements so far as is known contains more than a trace of gold.

ORIGIN OF THE DEPOSITS

In discussing the origin of the deposits the veins and replacements will be dealt with separately. In regard to the veins it will be necessary to take up first the origin of the vein fractures.

Uglow (pages 39, 40) believed that the rocks of the Cariboo series were folded and intruded by quartz porphyry sills prior to the deposition of the Slide Mountain series of late Palæozoic age. Further, that during the deformation the A veins were formed from the materials coming from the intrusives from which the sills were derived. Later settling caused cross range faults and these were healed with quartz and sulphides to form the B veins. Much later, possibly in Jurassic time, there was further deformation and settling forming northeasterly trending faults and crushing of the quartz veins (pages 39, 40). Close examination of the veins has shown that those occupying transverse and diagonal fractures, that is the so-called B veins, do not lie along faults in the sense claimed by Uglow.

The earliest quartz mineralization seen in the gold belt is in the form of narrow bed veins formed mainly or entirely by replacement of narrow bands of rock. These are known to be early because they are folded with the strata. Other bands of silicified clastic sediments are very similar to these veins, but they are clearly silicified rock bands and not quartz veins. They are cut cleanly by transverse quartz veins and the silicification shows no relation to them, suggesting that the silicified rock bands are decidedly earlier than the veins cutting them. Some beds of limestone, too, have been converted largely to quartz for lengths of hundreds of feet and some of these bands may have been silicified at this early date. It may be that some of the veins paralleling the strata or A veins may also have been formed early, but the writer has no information

on this point. On the other hand, since some of these A veins join transverse or diagonal veins, it is evident that some at least are of the age of the B veins.

After the formation of the early bed veins and the silicification of some beds, the belt was subjected to fracturing and the fractures were mineralized with quartz to form the transverse and diagonal veins. Some of the A veins were formed presumably at the same time as they have very similar mineralization and join transverse or diagonal veins.

The fractures in which the transverse and diagonal veins occur were formed after the rocks were folded and sheared. This is shown by the clean way they cross sheared rock, by their lack of deformation, by their change in strength and behaviour as they penetrate bands sheared in different degrees, and by details of replacement in the wall-rocks. Their parallelism and general similarity over distances of 8 miles or more suggest strongly that all formed as a result of one general system of stress and in one period.

The shapes and pattern of the fractures suggest that some were formed by compression, some by tension, and some by torsion. The minor transverse flexures occurring in some of the sheared rocks of the gold belt suggest compression parallel to the strike of the rocks. Torsional stress is suggested by sets of small, closely spaced, quartz-filled fractures occuring in *en échelon* arrangement. Many curving fractures filled by branch veins and also many straight vein-filled fractures appear to have been formed by tension.

While the fractures were being formed, or after they were formed, vein-forming solutions filled the fractures to form veins. As was previously stated, some veins have short, wedge-shaped branches projecting into the convex side of associated flexures. This suggests strongly that the flexures antedate the veins. If, as is suggested, the flexures are earlier than the veins, and considering that the flexures are associated with narrow fractures with no quartz and also with quartz veins of all sizes and that the width of the flexure is in all cases about the same, it follows that the veins were formed by filling of open spaces and not to any extent by replacement. It also follows that inasmuch as large open fractures could not exist, the fractures opened gradually as they were filled with quartz. This gradual widening may have been accomplished by pressure exerted by the vein-forming materials or by tensile stresses in the rocks. The writer believes that the vein-forming solutions were under pressure but that this pressure would not be sufficient to force the walls apart and, therefore, that the openings widened by tension. Veins formed in this way will taper to the ends, will tend to be widest in the central part of the fracture, and although they may be lenticular the tendency will be to uniformity in width with an absence of very wide bulges, and these are the characteristics of the gold belt veins. If the vein-forming solutions were well distributed or if the rocks were thoroughly fractured the tendency would be to form many small veins rather than a few big ones.

The wall-rocks of the veins contain much coarsely crystalline pyrite. Cubes of pyrite occur many feet from any vein, but a great many examples serve to show that pyrite is more plentiful near veins than at a distance of several feet, and there seems little doubt the pyrite was formed from

constituents moving outward from the vein fractures. Some beds are slightly silicified for a few feet from veins and some beds are much more pyritized than others. Limestone beds are silicified outward for variable distances, some are very siliceous throughout their known length, and others for only a foot from the point where they are crossed by a quartz vein. Another striking feature of the wall-rocks where veins traverse fissile rocks, particularly fissile black argillites, is the presence of thin wedges a few inches long of fine-grained pyrite tapering away from the vein and lying parallel to the fissility. Such wedges are very numerous and show very conclusively outward migration of vein constituents. Limestone beds in the Cariboo Gold Quartz mine show fairly complete replacement by fine-grained pyrite for variable distances from some veins. In some places this replacement extends outward only an inch or two and then gradually fades out, but supplies very good evidence that some limestones may be replaced far enough to make good ore-bodies.

The largest pyrite replacement body in the Cariboo Gold Quartz mine is in the area crossed by the Sanders zone of veins. In this case there is good evidence that the replacement ore was made by constituents moving outward from the quartz veins. The Island Mountain replacement body, however, is cut by very few veins and those responsible for the replacement ore are not evident. The body, however, is still imperfectly explored and the writer believes that the ore was supplied by penetrating quartz veins and that they will be found as development proceeds.

So far as is known the best ore-bodies lie in the base of the Baker member or in the much fractured, underlying Rainbow member. There is presumably a great difference in frangibility between the Rainbow member and the Baker member, with which can be associated much of the overlying Barkerville formation. Under the Rainbow member are rather solid members and below the Basal member a great thickness of relatively unyielding rock. The gold belt rocks as a whole would fracture more easily than those above or below and most stresses causing fractures would be relieved within the belt. Within the belt itself there are several members that are comparatively solid and unyielding, so that stresses would be relieved in a small part of the belt. This relief apparently took place in the Rainbow member, in the lower part of the Baker member, and locally in other members, particularly the Lowhee member. The Baker member appears to be the cover or cap of the best part of the gold belt and mineralization would be most prolific in the nearest rocks that permitted free circulation or movement of ore solutions. The solutions presumably rose to the Baker member which acted as a dam and forced them to remain in the fractured rocks below.

RÉSUMÉ AND POSSIBILITIES

The rocks of Cariboo district are mainly clastic sediments, some not sheared and others sheared in varying degree. The oldest rocks, known as the Cariboo series, are presumably Precambrian and have been divided into three formations. The oldest formation is the Richfield and over this lie the Barkerville and Pleasant Valley formations. The whole has been folded into a northwesterly trending anticline. The upper part of the

Richfield formation on the northeast side of the fold has been further subdivided into five members, listed below:

Baker member. Fissile and non-fissile, soft, grey, limy quartzite; limestone
Rainbow member. Fissile and non-fissile, interbedded argillite and quartzite; limestone
B.C. member. Black argillite
Lowhee member. Fissile and non-fissile, grey quartzite; limestone
Basal member. Black argillite

These members hold most of the gold deposits of value and the Rainbow member is the most important.

The mineral deposits are of two types:

(1) Gold-bearing pyritic quartz veins
(2) Gold-bearing pyritic replacement deposits

There are four classes of quartz veins.

(1) Large veins in earlier faults practically parallel to the strike and dip of the strata. These are not numerous and have been only slightly developed.

(2) Lenticular veins parallel to the strata. These are not numerous and have been only slightly developed.

(3) Transverse veins crossing the strata roughly at right angles. These are very numerous and many are of commercial value.

(4) Diagonal veins striking north 70 degrees east to east. These are second in numerical importance and many are of commercial value.

The known valuable veins are almost entirely in the Rainbow member. The pyrite replacement deposits are in limestone beds in the Rainbow member and in the lower part of the Baker member. One replacement deposit is of considerable commercial value.

The possibilities of the belt can be considered under as many heads as there are types of ore-bodies.

The transverse veins are in general 150 feet or less in length and 4 feet or less in width. Many are known to be of commercial value in the two mines of the district and none has been adequately exposed except in these two mines. The diagonal veins are in general a little wider and longer than those of the transverse type but are less numerous. The two main types have furnished nearly all of the ore taken from the Cariboo Gold Quartz mine to date. All of the ore from the mine has come from the Rainbow member. The rocks of this member are such, however, as favour short veins and, consequently, individual veins are rapidly worked out. The underlying B.C. member favours veins that are longer and wider. This member should, therefore, be explored near known ore-bodies along the strike of known zones of fracture with the hope of finding veins both valuable and persistent.

Workings in the Cariboo Gold Quartz mine are extensive enough to show that fractures occupied by commercial veins are in the main in several groups or zones. Individual veins in a group may not go far along the strike or dip, but others take their place and so far as is known there is no diminution in the number or size of veins from the surface to a depth of 600 feet. The surface, 1,200, and 1,500 levels at the mine show

a uniformity in the number and size of veins even though the veins at the three levels are all different. It would seem that uniformity is well enough established that its persistence to deeper and higher intermediate levels can be taken for granted and that any favourable block of ground in a vein zone can be counted on to supply an average amount of ore without previous blocking out of the veins. The more extensive the mining development the more accurate will be the estimate. As the veins are narrow obviously the profit from individual veins cannot be great and would be reduced considerably if development were so done as to block out each vein.

In the northwestern part of the belt the Rainbow member, because it lies between the B.C. and the Baker members and will consequently be much fractured, offers decidedly the best opportunities for the discovery of transverse and diagonal veins. In this part of the belt veins of this type are expected to be numerous. Better veins than those already discovered cannot be expected, but development should disclose approximately the same conditions as obtain in the workings of the Island Mountain and Cariboo Gold Quartz mines.

In the southeastern part of the belt the Rainbow member is not clearly the most valuable part of the belt. In this part of the belt the Rainbow and Lowhee members adjoin, are much alike in rock type, and presumably also in numbers and size of veins. The body of the rock in which the stresses would be relieved is much wider as it there includes two members, and, therefore, veins may not be so numerous per unit of area as they are where the favourable fracture belt is narrow.

Replacements of limestone appear to be very closely tied up with the transverse and diagonal veins. So far ore of this type has been found only in the Rainbow member and at the base of the Baker member. At the Cariboo Gold Quartz mine ore of this type occurs mainly where veins are numerous. This relation may not hold at the Island Mountain mine, but the source of the ore there is believed to be veins. In the northwestern part of the belt search for ore of this type should be confined as far as practicable to the two members in which ore-bodies of this type are known to occur. Whereas exploration for veins must be carried out mainly by tunnelling, search for replacements can be carried out by either of two methods. One method would be to diamond drill across the strata in order to locate beds of limestone, for the replacements occur only in limestone. The replacements may also be amenable to location by some methods of geophysical prospecting. It is an easy matter to locate limestone beds on the surface or by means of diamond drilling and the field of geophysical search can be confined to the immediate vicinity of the beds discovered.

The value of the veins parallel or roughly parallel to the strata has not been demonstrated. Most veins of this type in the belt are much wider than those crossing the strata and if they are ore bearing they may provide larger tonnages. None has been shown to be commercially valuable. In view of the apparent concentration of gold into the Rainbow member the veins of this type occurring in this member would presumably have the best chance of being ore bearing.

MINES AND PROSPECTS

This section of the report supplies information on the mines and mineral claims in the gold belt, and as the belt has not been traced satisfactorily northwest of the Island Mountain mine nor southeast of Grouse creek, only those properties that lie within these limits are included. The order in which the deposits are taken up is from northwest to southeast in the belt.

ISLAND MOUNTAIN MINES COMPANY, LIMITED

The holdings of the Island Mountain Mines Company, Limited, are northwest of the foot of Jack of Clubs lake. Underground exploration for lode gold began here in the seventies and several unprofitable attempts at mining had been made by 1890. After forty years of relative inactivity, exploration began again and underground development has been steady since 1932. In 1933 a valuable ore-body was discovered consisting of gold-bearing pyrite replacing limestone. Production on a 50-ton basis began in November, 1934, the ore being treated in a cyanide mill.

There are many old workings consisting of open-cuts, shallow shafts, and short adits, mostly caved and inaccessible, on the eastern and north-eastern slope of Island mountain. The newer workings are adits driven westward into the mountain from 80 to 650 feet above Jack of Clubs lake (*See* Figure 2). The main adit is 80 feet above the lake and the next most extensive adit, known as the Mid Lake, is 320 feet above the lake.

The newer underground workings are in the Barkerville gold belt and mainly in the Rainbow member. The rocks are so much disturbed by faulting that the detailed geology has not been worked out satisfactorily. The rocks are mainly argillites and argillaceous quartzites, all somewhat sheared. There are also several bands of impure limestone. The main adit supplies the most complete geological section. The rocks strike northwest and dip 45 degrees northeast. The section is given below. The widths given are the widths at right angles to the strike.

	Feet wide
Calcareous and argillaceous quartzite	300
White limestone and argillaceous and siliceous limestone	30–80
Argillaceous quartzite	150
Calcareous quartzite	10–20
Argillaceous quartzite	150
Argillaceous limestone	10
Argillaceous quartzite and argillite	300
Argillaceous limestone	20–60
Argillaceous quartzite	50
Grey quartzite	50

The white limestone near the top of the section is the one in which the largest replacement ore-body occurs. A few bands of soft, dark greenish grey rock in the upper half of the section may have been crystalline igneous rocks originally, but those examined in thin section appeared to be altered sediments although they could not be named definitely.

The rocks and mineral deposits are cut by faults. The largest fault strikes about north 15 degrees west and dips 45 to 60 degrees east. Neither the offset nor the direction of movement on this fault has been determined. Faults of similar strike and dip in the workings of the Cariboo Gold Quartz mine have offset the beds 400 to 1,000 feet and in all cases the

east side has been offset to the south. There are many faults of small throw, parallel or nearly parallel to the strata. In eight examples where quartz veins were offset by such faults the hanging-wall or northeast side has moved either downward or northwest so that the veins are offset a few inches to 30 feet to the northwest. No offsets were seen in the opposite direction, but the faults are probably all normal. In several the direction and extent of movement could not be determined.

The mineral deposits are of two types:

(1) Gold-bearing pyritic quartz veins
(2) Gold-bearing pyritic replacement deposits in limestone

Most of the quartz veins strike north 30 to 60 degrees east and dip steeply southeast. The veins of this strike range in width from a fraction of an inch to several feet, but all except a few are less than 1 foot wide. A few veins strike north 80 degrees east and dip steeply south, and these range in width from a fraction of an inch to 6 feet and most are wider than 1 foot.

The main level (*See* Figure 1), totalling more than a mile of underground work, cuts about two hundred quartz veins. Only eight of these have been followed by drifts, although several others are more than 1 foot wide. One vein has been followed by a drift for 350 feet, and one for 200 feet, but none of the others is known to be so long. Some veins consist of long narrow lenses joined end to end by a narrow vein, some of slightly overlapping lenses, and some are uniform in width. The lenses are 20 to 150 feet long. Overlapping or *en échelon* lenses are characteristic of one of the veins and going along the vein the next succeeding lens is found to the left. Some branch veins are exposed but little is known of their behaviour.

The veins consist of quartz, sulphides, and free gold. In a few, sulphides make up more than 25 per cent of the veins by volume, but in general sulphides are less plentiful. The sulphides are coarse grained and consist of pyrite and arsenopyrite with minor quantities of sphalerite, galena, chalcopyrite, and, probably, galenobismutite and cosalite. Arsenopyrite appears to be somewhat more plentiful than in most other places in the Gold Belt, but probably does not constitute more than 1 per cent of the sulphides. No coarse gold has yet been seen in the veins, but gold probably ranges in size of grain from pieces of nugget size to very small specks as in the Cariboo Gold Quartz mine. Scheelite occurs but is rare. Some of the veins contain tan-coloured ankerite and some have thin films of sericite. Some veins where they penetrate limestone beds also contain calcite.

The replacement type of ore is being developed in the main adit. The deposit consists of pyrite with some arsenopyrite and very minor amounts of chalcopyrite, galena, sphalerite, gold, scheelite, and, probably, cosalite. The gold is partly in narrow fractures cutting the sulphides and partly as small grains included in sulphides and is very fine grained, in general finer than 400 mesh. Where replacement has been less intense, as at the borders of the ore-body and in streaks of shaly limestone, the pyrite cubes are as large as those of the veins. The more massive ore is fine grained and is in sharp contrast with the coarse-grained sulphides of the veins. Gangue is small in amount and consists of quartz, calcite, and a small amount of ankerite, and possibly some dolomite.

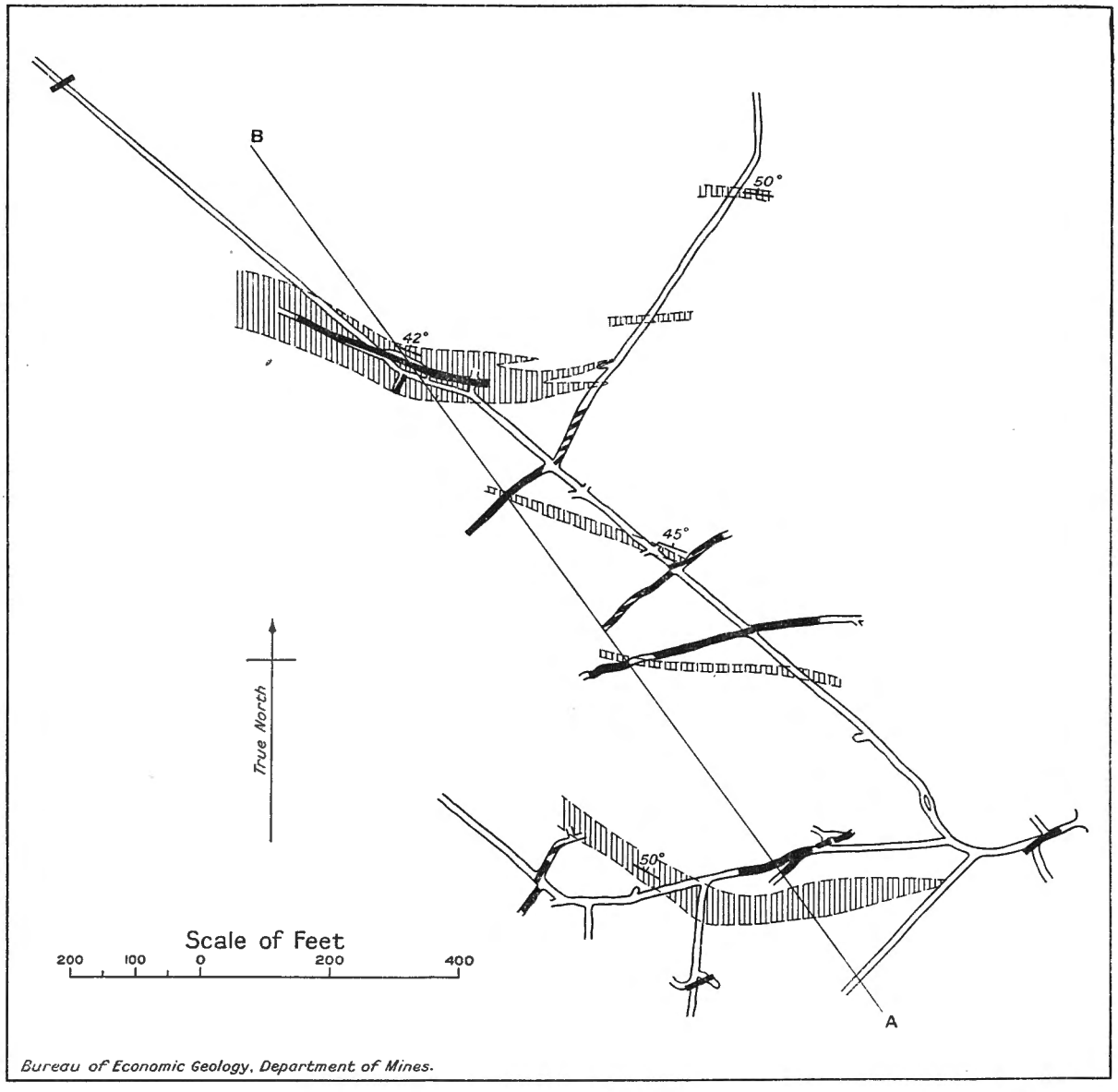

Figure 1. Island Mountain Mines, Limited, plan of main adit showing positions of principal mineral deposits (heavy black lines) and of calcareous bands (vertical ruling); A-B, line of section, *See* Figure 2.

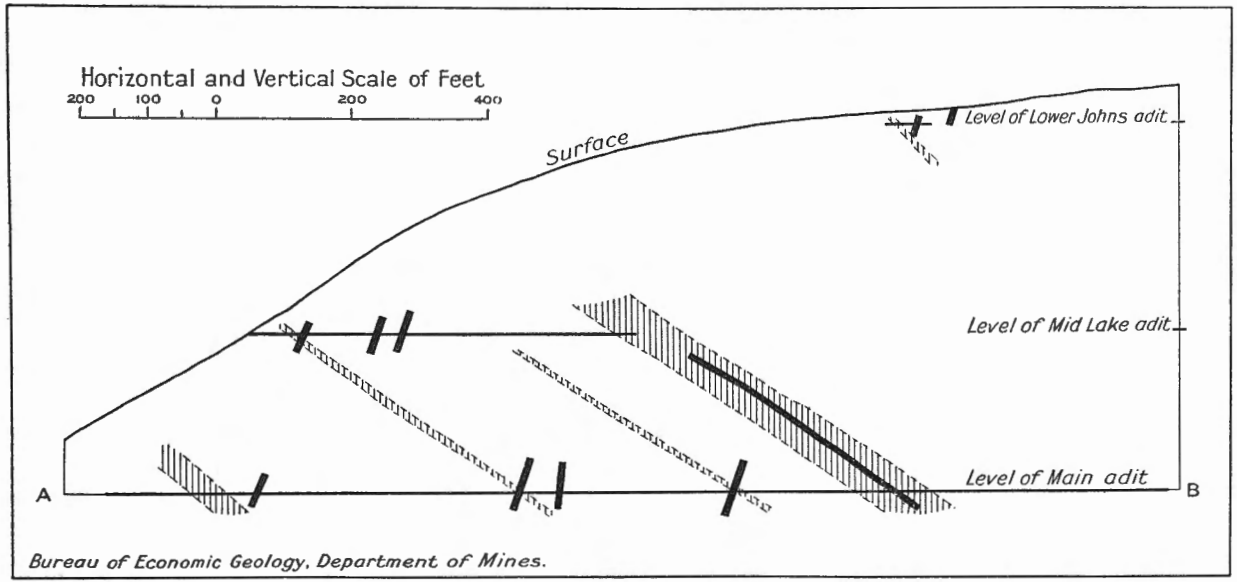

Figure 2. Island Mountain Mines, Limited, vertical section along line A-B, Figure 1, showing positions of principal mineral deposits (heavy black lines) and of calcareous bands (vertical ruling); extent of underground workings at the various levels is indicated by horizontal lines.

The replacement body in the main adit has been followed by drifts for 300 feet. The width varies from a few inches to 9 feet. It has been followed up the dip for a distance of 280 feet (September, 1934) on an average dip of 42 degrees. The body is not a single deposit, but is really several lenticular bodies separated by thin bands of argillaceous rock. The limestone beds in which the ore occurs split to the southeast into thinner bands separated by argillite and finger out. The ore also acts in the same way and the bodies end to the southeast by splitting into tapering wedges. This limestone bed occurs in the Mid Lake adit also.

In the Mid Lake adit another calcareous bed 350 feet southwest of the main limestone bed has been partly replaced by pyrite. This bed lies in approximately the same stratigraphic position as the one second from the bottom of the four cut in the main adit.

The grade of the replacement ore so far developed is roughly twice as high as the grade of the better veins and should average about one ounce of gold a ton.

CARIBOO GOLD QUARTZ MINING COMPANY, LIMITED

The Cariboo Gold Quartz mine is southeast of Jack of Clubs lake on the northern slope of Cow mountain, which rises to the south between the lake and Lowhee creek. Some underground work was done on Lowhee creek as early as 1877 on showings now part of the holdings of the present company. The present owners began to explore their ground in 1927 and began milling on a 50-ton basis in 1933. In 1934 the rate of milling was increased to 100 tons a day. The gold is extracted by cyanide. In 1933 the mine produced 7,660 ounces of gold from 19,869 tons of ore.

Several adits have been driven west into Cow mountain from Lowhee creek at the upper camp, but the main underground workings are adits driven southeast into the mountain from the main camp at the foot of Jack of Clubs lake. Underground work on the levels exceeds 4 miles. The lowest adit from the main camp is the 1,500. The 1,200 adit is 315 feet higher and directly over the 1,500 adit. Between the two adits are the 1,300 and 1,400 levels connected by raises to the 1,500 and 1,200 levels. The 1,600 level is 105 feet below the 1,500 level and is connected to it by raises (*See* Figures 3 and 4).

The 1,500 level furnishes a good cross-section of the rocks. This level crosses from the Baker member or near it through the Rainbow member into the B.C. member. The rocks strike northwest and dip about 45 degrees northeast. The Rainbow member is 750 feet wide on the level and in part of the level can be subdivided into four divisions. The lowest, 2a of Figure 3, is 150 to 300 feet wide and consists of fissile and non-fissile grey quartzites. This division widens from northwest to southeast. The upper part of No. 2 of Figure 3 above this, is 200 feet wide and consists of fissile and non-fissile, interbedded, argillaceous quartzites and argillites. The next or No. 3 division of Figure 3 is 100 to 150 feet wide and consists of fissile and non-fissile grey quartzites. No. 4 division is 250 to 300 feet wide and in the northwestern part of the level consists of fissile and non-fissile, interbedded argillites and quartzites. Above this are fissile and non-fissile, grey quartzites exposed for a width of 200 feet. This upper quartzite may

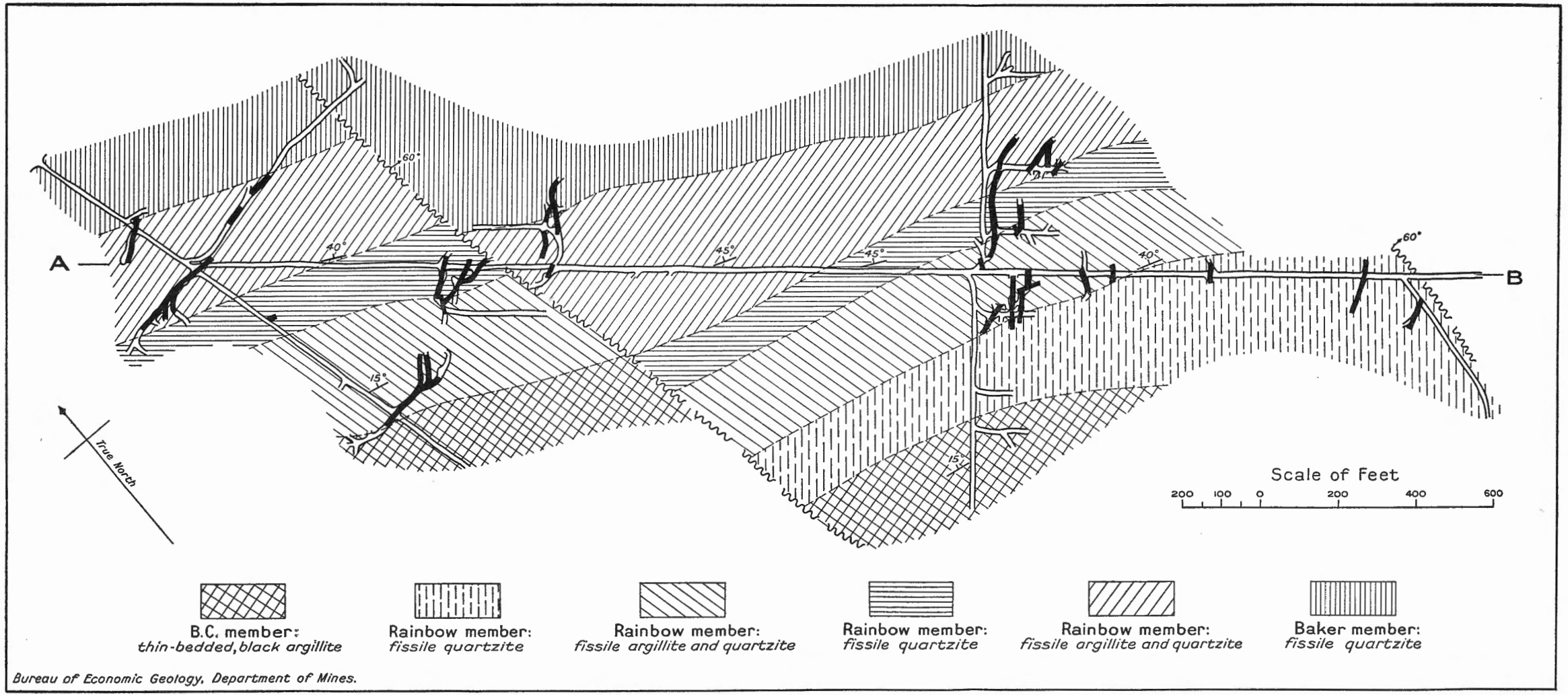

Figure 3. Cariboo Gold Quartz mine; plan of 1,500 level showing positions of principal mineral deposits by heavy black lines. For line of section A-B, *See* Figure 4.

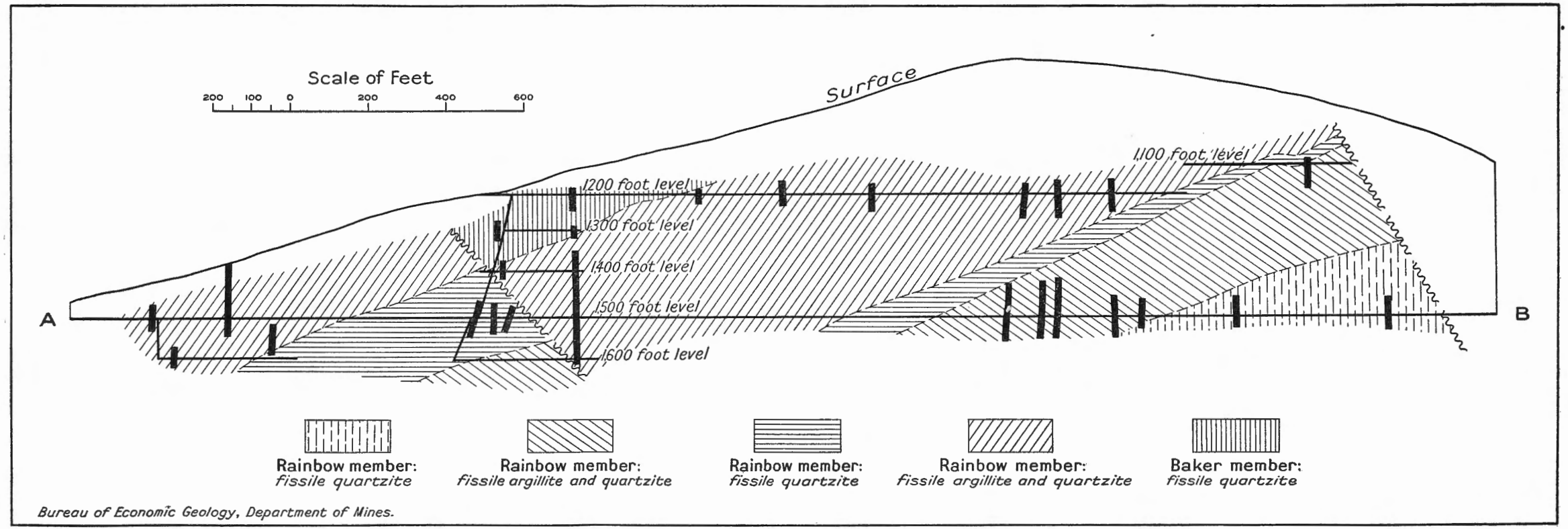

Figure 4. Cariboo Gold Quartz mine; vertical section along line A-B, Figure 3, showing positions of principal mineral deposits by heavy black lines, and extent of underground workings at various levels.

be part of the Baker member or may underlie it and be part of the Rainbow member. In these uppermost quartzites near their base is a fairly extensive calcareous horizon. In most places it includes two or three beds of white limestone each about a foot wide separated by a few feet of grey calcareous quartzite. No. 3 division also holds a narrow calcareous horizon which is quite persistent and in one of the places where it was cut it was replaced by fine-grained pyrite to make an ore-body 8 inches wide. This horizon elsewhere on the level was a highly silicified calcareous bed. Near the base of the upper part of No. 2 of Figure 3 are two or three calcareous argillite beds. These could not be recognized at all places where this division was crossed, but at least one has been replaced locally to form a body of replacement ore 18 inches wide. Another narrow limestone bed occurs near the top of the lower part of No. 2 division. At one place this bed is white silicified limestone about a foot wide, elsewhere it is either calcareous quartzite or a fine-grained, soft rock resembling marl.

The rocks have been subjected to two or more periods of fracturing. There are many transverse fractures and several hundred of these contain quartz veins. These fractures do not show displacement of the walls and are not faults. Later than these fractures are faults that strike in three principal directions. A few faults with very small throw lie along some of the quartz veins and strike north 60 to 80 degrees east. These faults are offset by other faults that parallel the strata. These also are mainly at least of small offset and are apparently all of the normal type. Two faults, the Rainbow and Lowhee faults, strike roughly north and dip about 60 degrees east. These are of much greater magnitude and are crushed zones 20 feet or more wide and show horizontal displacement of the strata of 400 feet and 1,000 feet respectively. In both cases the east side is displaced to the south, suggesting that the faults are of normal type. The relationship between these and the other faults is not known.

The mineral deposits are of two types:

(1) Gold-bearing, pyritic, quartz veins
(2) Gold-bearing, pyritic, replacement deposits

The veins are of three types, transverse veins that strike north 30 to 60 degrees east and cross the strata roughly at right angles, diagonal veins that strike north 70 degrees east to east and cross the strata diagonally, and strike veins that are parallel or nearly parallel to the strata. The transverse and diagonal veins appear to be closely related or were formed at the same time, but the strike veins may have formed at a different time. Many transverse and diagonal veins are commercially valuable, but no strike vein is yet known to be of value.

Transverse veins are the most numerous and about seven-eighths of these are less than a foot wide. The remainder, forty to fifty veins, range in width from 1 foot to 6 feet and most of these average about 3 feet. They are in general less than 150 feet long and rarely exceed 200 feet. The diagonal veins are less numerous and about three-quarters of them are narrow and the remainder, fifteen to twenty veins, are more than a foot wide. These wider veins also average about 3 feet wide, appear to be somewhat longer than those of the transverse type, but rarely exceed 300 feet. Both types are vertical or steeply dipping. Both

have numerous branches. Many of the larger branches of the diagonal veins follow the direction of the transverse veins and appear to be transverse veins joining stronger diagonals. Many branches are curving and have no prevalent direction of strike. The types instead of crossing each other commonly join in a jumble of veins suggesting that the vein fractures were formed by one stress and at the same time.

The two types are alike in mineralization. They are quartz veins, many of which have some tan-coloured ankerite, particularly along the walls, and some of them contain some sericite. They contain as a rule sulphide ranging up to 50 per cent by volume. The sulphide consists of pyrite with some arsenopyrite and small amounts of sphalerite, galena, galenobismutite, and cosalite.[1] The sulphides are very coarse grained and pyrite cubes one inch to the side are not uncommon. Free gold occurs with the sulphide in grains of all sizes from nuggets down to minute specks. Nugget gold amounts to an ounce in about 50 tons of ore. The galenobismutite and cosalite occur sporadically in small bunches commonly associated with much coarse gold. The veins also contain small quantities of scheelite and a minute quantity of a telluride. The quartz, ankerite, pyrite, and arsenopyrite are early in the vein formation, but the galenobismutite, cosalite, and gold associated with these minerals, and also some galena commonly spread out from small nests into cracks traversing the earlier vein matter. These minerals are, therefore, late in the period of vein formation. Some of the gold is included in early sulphides and appears to have been deposited early.

A noteworthy feature pertaining to the relation of the veins to the country rock is well exemplified at the mine. The veins rarely cross through divisions of dissimilar rock type. Many veins traverse only part of one division. The explanation of this behaviour is presumably that the different rock types reacted differently to the fracture forming stresses. At one place one division yielded by fracturing more easily than an adjoining division, and at another place the second division yielded more easily than the first. In general, however, soft calcareous sediments and graphitic schists rarely fractured. The best fractures appear to be in slightly fissile argillaceous quartzites.

Although the veins exposed by the 1,500 level occur throughout the level, there are three groups of veins where the veins are bigger or more closely spaced or more persistent. The two groups nearest the portal were made by the joining of several fairly strong transverse and diagonal veins. The third group is the Sanders vein zone, consisting of several parallel, persistent, transverse veins. There appears to be another group of parallel transverse veins on the Pinkerton and Goldfinch claims, but underground development although it has cut one or more of the Pinkerton veins has not been extensive enough to show that there is a group at depth.

Several transverse or diagonal veins and also a large strike vein are exposed on the Cariboo No. 1 claim south of the present face (September, 1934) of the 1,500 level. The strike vein called the Wells vein consists of a number of closely spaced, 6-foot veins across a width of 20 to 50 feet.

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[1] Galenobismutite and cosalite have been identified by H. V. Warren. "Mineralogy of the Cariboo Gold Quartz Mine"; The Miner, vol. 7, No. 7, pp. 287-288 (1934).

The veins are lenticular and may join to make a wide, solid body locally. The vein appears to be a bed vein parallel to the strata and not in a fault fracture. If it is truly a bed vein it may pinch or swell considerably within short distances. Several, large, rounded, pyritic quartz boulders 10 feet in diameter on Lowhee creek near the upper camp have presumably travelled only a short distance from their source. They may have come from the B.C. vein, exposed a mile away, from its unexplored northwesterly extension, or from a similar large vein nearby.

The replacement deposits are bodies of massive, fine-grained sulphides consisting of pyrite and some arsenopyrite and small quantities of galena and sphalerite. Free gold occurs in narrow fractures traversing the sulphides and also as small grains enclosed in sulphide. The gold is very fine grained and most of it would pass through a 400-mesh screen. The largest deposit so far discovered is 18 inches or less wide and less than 100 feet long.

The grade of the replacement ore is roughly twice as high as that of the better veins. The grade of the ore mined in 1933, consisting entirely of vein ore, approximated 0·4 ounce a ton. In this first year of mining, however, there was some lowering of grade due to a greater amount of dilution than will ordinarily occur, and the veins will probably average a little higher.

UPPER LOWHEE CREEK

The upper part of Lowhee creek south of the holdings of the Cariboo Gold Quartz Mining Company is covered by the Champion and Black Bull claims. Hydraulic washings have laid bare much of the bedrock in the valley bottom and exposed a number of quartz veins both of the transverse and of the diagonal types. One of the diagonal veins about 1,200 feet below Watson gulch is 4 feet wide. The other veins seen were narrower.

CARIBOO CENTRAL GOLD MINES, LIMITED

Part of the holdings of the Cariboo Central Gold Mines, Limited, lie in the lower part of the gold belt southwest of the head of Lowhee creek, but no mineral deposit was examined.

B.C. VEIN

The B.C. vein is on the Cariboo claim a few hundred feet northeast of the Lowhee Creek-Stouts Gulch divide. The vein has been known for many years and attempts to mine were made as early as 1876. The vein strikes southeast along the southwestern slope of Barkerville mountain, dips 70 degrees northeast, and is 20 feet wide. It has been traced by very scattered outcrops in heavy drift for a length of 400 feet. An adit driven northeast cuts the vein 55 feet below the surface. A shaft is reported to follow the vein down to a depth of 170 feet and short drifts have been driven on the adit level and on a sub-level 110 feet below the outcrop. In general where exposed the vein contains very little sulphide, but the dump shows that much sulphide existed in the vein matter that was taken out. In the small part of the workings that are accessible, transverse or branch veins occur containing much sulphide and a normal transverse vein

content of gold. The vein is in black argillites of the B.C. member and although it is nearly parallel with the strata is not a bed vein but has come in along a fault. In view of this the vein will probably have a greater length, depth, and a more uniform width than the large lenticular bed veins of the district.

MYRTLE CLAIM

The Myrtle claim is on Barkerville mountain northeast of the Lowhee Creek-Stouts Gulch divide. The claim spans the Rainbow member and includes a part of the top of the B.C. member, and perhaps also a part of the base of the Baker member. The rocks are argillaceous quartzites and black argillites, in general dipping 50 to 60 degrees northeast.

Open-cuts in argillite in the western corner of the claim expose several closely spaced parallel quartz veins each 1 foot wide or wider. They contain very little sulphide. A succession of trenches crossing the claim in a southeasterly direction expose many narrow, transverse, quartz veins striking about north 30 degrees east, a few veins 1 to 2 feet wide, some striking north 30 degrees east and some north 70 degrees east to east, and one bed vein 2 feet wide. Some of the transverse and diagonal veins are well mineralized with sulphides. A long cluster of trenches and other open-cuts crossing the claim, roughly from west to east, also expose many veins, one of which has been traced for 300 feet. In these cuts most of the narrower veins and some of the wider veins strike north 30 degrees east, but the longest and widest vein strikes north 75 degrees east. This largest vein, a few inches to 4 feet wide, is in grey to dark grey quartzite and ends in fissile black argillite. Some of the veins are well mineralized with sulphides. Near the northeast side of the claim a lens of quartz 10 feet wide lies parallel to the strata. A surrounding trench exposed quartz veins, but proves that the wide quartz lens is very short.

CARIBOO, MARIE, AND MARTHA CLAIMS

The Cariboo, Marie, and Martha claims are on Barkerville mountain and adjoin the Myrtle claim on the southeast. Open-cuts segregated into three clusters extend from the southern corner of the Cariboo claim through the eastern corner of the adjoining Marie claim and into the western corner of the adjoining Martha claim. The rocks exposed by the cuts are mainly argillaceous quartzites apparently of the Rainbow member.

On the Cariboo claim a short adit was caved and inaccessible, but the open-cuts disclose several roughly parallel transverse quartz veins striking about north 30 degrees east. The veins are 2 feet or less in width and are locally well mineralized with sulphides in which pyrite is the commonest mineral, but in which galena is conspicuous. This cluster of cuts extends into the Marie claim.

In the Marie claim the open-cuts of the second cluster disclose many narrow quartz veinlets, two bed veins, 2 and 4 feet wide, and two veins 18 inches and 2 feet wide striking north 30 degrees east. The larger bed vein joins with the larger transverse vein.

The third cluster of cuts is mainly on the Martha claim but is partly on the Marie. These cuts expose both bed and transverse veins, mostly of small size. One 18-inch vein has been traced for 150 feet. Some of the veins are well mineralized with pyrite.

MORNING STAR AND EVENING STAR CLAIMS

There are many open-cuts and long trenches on the Morning Star and Evening Star claims, situated on the southeast slope of Barkerville mountain, southeast of the Martha claim. The claims are underlain mainly by the Rainbow member but take in also the lower part of the Baker member, part of the B.C. member, and the upper part of the Lowhee member. The rocks of the Rainbow member are mainly argillaceous quartzites. There is a band of calcareous rock and limestone 100 feet wide on the Evening Star claim near the top of the Rainbow member, and on the same claim another 100-foot band of calcareous rock near the base of the Baker member.

Open-cuts on the Morning Star above the B.C. ditch expose several closely spaced bed veins, each 2 to 3 feet wide striking south 25 degrees east, three 2½-foot veins striking north 80 degrees east to south 75 degrees east, three veins 2 to 4 feet wide striking north 50 degrees east, and several veins 1 foot wide or narrower striking north 20 to 30 degrees east. Some of the veins are well mineralized with pyrite and galena.

The trenches on the Morning Star expose one vein zone consisting of about 10 closely spaced bed veins each about a foot wide, and doubtfully traced for 300 feet. This vein zone is in the upper part of the Lowhee member. Another trench exposes a southeasterly striking vein in a fault fracture. The vein has been traced for 400 feet and varies in width from a few inches to 4 feet. There are also several transverse veinlets.

On the Evening Star claim there are several narrow quartz veins, some of which strike east and one of which strikes south 20 degrees east. The southeasterly striking vein occupies a fracture, has been traced for 400 feet, and is in general less than 2 feet wide.

UPPER STOUTS GULCH

Upper Stouts gulch is underlain by grey quartzite and argillaceous quartzite of the Lowhee member. One narrow band of coarser clastic rock traced for 1,000 feet is exposed on the Mucho Oro claim and farther northwest, and may be tuffaceous in origin.

There are at least three groups of quartz veins on Stouts gulch above the Mucho Oro claim and other scattered veins. Six or more quartz veins 2 to 8 inches wide, 2 feet apart, and all striking about north 10 degrees east and dipping 70 degrees west, occur a short distance southwest of the head of the gulch. Another group of parallel veins occurs 600 feet southeast. There are fifteen or more veins in this group all striking north 30 degrees east and dipping steeply northwest. Most of these veins are very pyritic and some have as much as 50 per cent pyrite by volume. Another group of fifteen veins occurs 900 feet southeast from the head of the gulch. Most of these strike north 20 degrees east and some strike north 60 degrees east and all dip steeply northwest. Those striking north 60 degrees east are 1 foot wide and the others are narrower. Several of the veins are well mineralized with pyrite. At this place grey quartzites have been replaced by pyrite in a band a foot wide. A sample of the replacement sulphide was assayed but returned only a few cents in gold. There are several quartz veins striking about north 30 degrees east from 1,300 to 1,600 feet southeast of the head of the gulch.

Quartz pyrite veins are exposed at several places on the Mucho Oro claim. Most of these strike north 20 to 50 degrees east and at least one is a diagonal striking south 70 degrees east.

WINTRIP CLAIM

The Wintrip claim is on lower Stouts gulch and adjoins the Mucho Oro claim on the southeast. The northwestern part of the claim is underlain by the Lowhee member and the southeastern part by the Rainbow member.

Several narrow veins are exposed in the southeastern part of the claim and one larger vein that was explored in 1933 by the Britannia Mining and Smelting Company in an adit 350 feet long. In this adit a vein 6 inches to 3 feet wide has been followed for 80 feet. This vein strikes north 50 degrees east and dips steeply northwest. Another 3-foot vein striking south 80 degrees east and vertical was drifted on for 40 feet. Both veins are well mineralized with pyrite. A 3-foot quartz pyrite vein on the surface strikes south 80 degrees east and is vertical and may be the one of similar strike found underground. A large quartz-pyrite boulder 15 feet by 6 feet near the portal of the adit is presumably nearly in place and suggests that wider veins occur nearby.

SHAMROCK GOLD MINES, LIMITED

Several open-cuts and an adit were visited on ground explored in 1933 by the Shamrock Gold Mines, Limited. This ground consists of the Progress, Shamrock, and other claims northwest of Barkerville.

The northeastern claims are underlain by the Barkerville formation and those to the southwest by the Baker member of the gold belt. The rocks of the Baker member where exposed along the B.C. ditch consist mainly of fissile, grey, calcareous quartzites and are intruded by two or more dykes or sills of quartz porphyry. Two bodies of quartz porphyry have been explored by open-cuts and contain much quartz in vein form. The quartz porphyry bodies appear to be dykes or sills striking east to south 70 degrees east.

On the Progress No. 8 claim near its southern boundary a short adit and open-cut inadequately expose quartz-sulphide mineralization in quartz-porphyry. Large blocks of sulphide on the dump consist of galena, black sphalerite, and pyrite. This open-cut is presumably on the Home Rule ledge of old reports. About 500 feet east of this open-cut are three other openings, the upper on the N.M. No. 3 fraction and the other two in the southwestern corner of the Progress No. 7 claim. The one on the N.M. No. 3 fraction discloses a 2-foot quartz vein in grey schists. One of those on the Progress No. 7 claim is a short caved adit and the other is an open-cut 100 feet farther east. The open-cut exposes a quartz vein 3 feet wide. Blocks of sulphide consisting of pyrite, galena, and black sphalerite are seen on the dump. The massive sulphide is very similar to that seen elsewhere in the southern part of the gold belt replacing limestone. The vein exposed in this open-cut is presumably the Dooley ledge of old reports. About 700 feet farther east on the Progress No. 7 claim is another open-cut in limestone and grey schists. The limestone is partly replaced by pyrite. This cut is probably near the base of the Barkerville formation.

An adit has been driven westward toward the open-cuts from the Barkerville road a few hundred feet north of Barkerville. The adit is 2,000 feet long and penetrates through the lower part of the Barkerville formation into the Baker member of the gold belt. Quartz veins are rare in the adit but some occur and one 1,000 feet from the portal contains pyrite and near the vein limestone has been replaced by pyrite and black sphalerite. Several strong fractures cross the adit 500 feet from the portal. They strike northeast and are branches of a northeasterly striking fault.

SIRIUS CLAIM

The Sirius claim is on the eastern slope of Barkerville mountain a short distance northwest of Barkerville. The claim is underlain by fissile grey quartzite of the Baker member intruded by two or more sill-like bodies of quartz porphyry. An open-cut at the B.C. ditch, about 50 feet south of the southern boundary of the Progress No. 8 claim, exposes a body of quartz porphyry holding a quartz vein 1 to 5 feet wide and many irregular quartz veinlets. About 200 feet east are two other open-cuts, both in quartz porphyry holding much quartz in irregular veins.

WESTPORT, BLACK JACK, DILLER, AND BLACK JACK EXTENSION CLAIMS

The claims listed above extend from Barkerville to the south and cover the junction of Williams creek and Stouts gulch. The Diller claim is underlain mainly by grey calcareous quartzites of the Baker member. The Westport claim is underlain mainly by quartzites of the Lowhee member, and the other two by argillites and quartzites of the Rainbow member.

A number of quartz veins are exposed on Williams creek on the Westport claim and in 1933 the Britannia Mining and Smelting Company drove three short adits on this claim, northwestward from Williams creek. Two of the adits are only 10 to 20 feet long. One crosscuts a 2-foot quartz-pyrite vein striking north 70 degrees east and both expose several quartz-pyrite veinlets striking north 70 degrees east. The third adit is 250 feet long and crosses several parallel quartz stringers striking north 25 degrees east and five quartz-pyrite veins each from a few inches to 2½ feet wide, striking north 15 to 35 degrees east.

An open-cut in the southwest corner of the Black Jack claim exposes three veins striking north 60 degrees east, south 80 degrees east, and south 30 degrees east. The north 60 degrees east striking vein is 2 feet wide. A short adit nearby cuts many quartz veins from 1 inch to 2 feet wide very well mineralized with pyrite. Near the northeast corner of the claim another adit driven by the Britannia Mining and Smelting Company in 1933 is 160 feet long. A large shallow pit at the portal of the adit exposes many parallel quartz-pyrite veins a few inches to 1 foot wide striking north 60 degrees east and making a vein zone 50 feet wide. Early reports state that 200 tons were mined from this pit and a shaft. The adit crosscuts another group of parallel veins striking north 50 degrees east and extending across a width of 25 feet. There are also several narrow bed veins at this place.

In the northern corner of the Black Jack Extension claim and on the southern part of the adjoining Diller claim are a great many quartz veinlets

striking about north 25 degrees east and dipping 70 degrees northwest across a band 400 feet wide. There are also in this band a few narrow veins of the diagonal type. Near this vein zone are two or more beds of limestone, one of which has been extensively replaced by quartz.

MAMMOTH CLAIM AND WILLIAMS CREEK SOUTH OF BLACK JACK GULCH

An open-cut on the southern bank of Black Jack gulch on the Mammoth claim exposes three quartz veins in fissile grey quartzite of the Lowhee member. One is a transverse vein 6 feet wide striking north 30 degrees east and dipping 70 degrees southeast. Another is 2½ feet wide, strikes south 15 degrees east, and is vertical. Joining these two is a third vein 2 feet wide and about 30 feet long striking north 70 degrees east. The veins do not show much pyrite but the transverse vein in particular has many pits formerly occupied by pyrite cubes.

Bed veins are exposed in the northwest corner of the Bonita claim. A bed vein is exposed in an open-cut west of Williams creek on the Westport claim. Bed veins and transverse veinlets, both mineralized with pyrite, occur east of Williams creek on the Mammoth claim. There are several veins of the bed and transverse types near Williams creek on the Royal Oak and Pilot claims. A short distance below Walker gulch the sediments have been partly replaced by thin seams of pyrite on the Cornish and Mint claims. There are also quartz veins in the vicinity. A quartz vein opposite the mouth of Walker gulch on the Mint claim strikes about south 60 degrees east and appears to be vertical. It is at least 2 feet wide and is well mineralized with pyrite and some arsenopyrite and chalcopyrite. This is apparently the Steadman ledge of old reports. Argillites of the Basal member underlie much of Williams creek south of Walker gulch and quartz veins are few.

CARIBOO-AMALGAMATED GOLD MINES, LIMITED

The Cariboo Amalgamated Gold Mines, Limited, has holdings in various parts of Cariboo district. In 1933 the company drove an adit to explore holdings a mile south of Barkerville. The adit is 900 feet long and was driven east-southeast, beginning on the Alder fraction and extending into the Liberty claim through rocks of the Lowhee member. The adit cuts a few veins, one of which is a bed vein 2 to 6 feet wide containing some pyrite. It cuts also a diabase dyke assumed to be of Mesozoic age. The objective of the adit was surface showings farther southeast on the Liberty and Free Gold claims.

There are several open-cuts exposing veins on the Free Gold claim. The cuts are somewhat caved and the veins are poorly exposed. These are apparently the same open-cuts that were visited by Uglow and were then included in the Victory claim. He states that veins on the Victory claim were mineralized with pyrite, arsenopyrite, and galena, and contained high values in gold.[1]

[1] Johnston, W. A., and Uglow, W. L.: "Placer and Vein Gold Deposits of Barkerville, Cariboo District, B.C."; Geol. Surv., Canada, Mem. 149, pp. 196-205 (1926).

WILKINSON, PROSERPINE, AND PROSERPINE SOUTH CLAIMS

The above-mentioned claims are south of Barkerville between Williams creek and Conklin gulch. The Wilkinson and Proserpine claims are underlain mainly by the Rainbow member, and the Proserpine South claim, which adjoins the Proserpine on the southwest, is underlain mainly by rocks of the Lowhee member.

A long line of shafts, short adits, and trenches extends from the Wilkinson claim south-southeast across most of the Proserpine claim. The openings are presumably on a long, wide vein, for there is much quartz on the dumps of some of the shafts. The vein is visible in one of the cuts on the Proserpine claim and is there 5 feet wide but is not well enough exposed to show its relationship to the bedrock. This line of openings is on the Proserpine ledge of old reports, which was explored first by Mr. Wilkinson in 1864. The vein is reported to contain pyrite, arsenopyrite, and galena in quartz.

Open-cuts and a short adit on the Proserpine claim 500 feet northeast of the northwest corner of the claim expose two narrow quartz veins striking north 60 degrees east and north. Quartz on the dump of the adit contains pyrite and is so plentiful as to suggest that larger veins were cut in the adit.

A group of trenches and shafts mostly on the Proserpine claim, but partly on the northeastern part of the adjoining Proserpine South claim, expose several veins. A trench and shaft in the southeastern part of the group disclose two veins, one of which is vertical, strikes north 19 degrees east, is 2 feet or less wide, and is mineralized with pyrite. The northwestern trenches expose several veins striking north 10 to 15 degrees east, one of which is well mineralized with pyrite. In 1933 Island Mountain Mines Company, Limited, drove a crosscut adit from the Proserpine South claim eastward under this group of surface openings. The adit is 975 feet long. It is a crosscut to the east for 600 feet and from the end of the crosscut is mainly drift to the north-northeast under the northwestern part of the surface openings. The easterly drive cut a few small bed veins. The northerly drive disclosed one quartz-pyrite vein at least 6 feet wide striking north 30 degrees east and branch veins 2 feet or less in width also mineralized with pyrite. This vein is disturbed by a fault roughly parallel to it, but appears to pinch to the north to several branching quartz-pyrite veins each 1 foot or less wide that strike north 20 to 30 degrees east and end at an easterly striking fault near the north end of the workings. This vein has been drifted on for 140 feet.

CONKLIN, PROSERPINE EAST, AND PENELOPE CLAIMS

The above-mentioned claims are south of Barkerville between Williams creek and Conklin gulch and adjoin the Proserpine claim on the southeast. The Conklin claim appears to be underlain entirely by fissile quartzites of the Baker member and the Proserpine East and the Penelope claims by rocks of the Rainbow member.

Two caved adits and a caved shaft on the Conklin claim do not now expose vein matter. A quartz vein 4 feet wide, striking north 55 degrees east, outcrops a few feet from the shaft. There is an old 4-stamp mill below the upper adit.

Open-cuts in the southern corner of the Proserpine East claim disclose two quartz veins 1½ and 2 feet wide striking north 65 degrees east and north 80 degrees east respectively. Each vein has been traced for 60 feet. No vein was seen in the open-cuts on the Penelope claim.

PROSERPINE SYNDICATE

The Proserpine Syndicate holds a group of claims between the Penelope claim and Grouse creek. Shafts, short adits, and open-cuts were opened many years ago, and the present holders have continued surface exploration and have extended some of the adits and driven others.

The claims are underlain by the Rainbow member and by the lower part of the Baker and the upper part of the Lowhee members.

Workings are clustered along the northeast side of the Warspite claim and consist of the Warspite adit 440 feet long, the Warspite and another shaft, and a number of trenches. The adit cuts a bed vein and a few narrow transverse veins. A shaft 34 feet deep follows a vein 1 foot wide down to the adit. This vein is of the transverse type and is well mineralized with pyrite. At the time of the writer's visit the adit had penetrated a light-coloured rock full of irregular quartz veinlets. The rock is too much altered for identification but is believed to be a quartz porphyry. The Warspite shaft is on a quartz vein approximately parallel to the strata. Where seen it was 1 to 4 feet wide and well mineralized with pyrite, and is reported to be much wider in some places. In open-cuts nearby are quartz veinlets, striking north 15 to 35 degrees east, mineralized with pyrite and galena.

Surface workings extend from the eastern corner of the Warspite claim eastward into the Blighty claim and southeastward along the northeast side of the Tipperary claim. There is a diagonal vein 1 to 2 feet wide striking north 75 degrees east in the eastern corner of the Warspite claim and nearby in the Blighty claim is a 3-foot vertical vein striking south 40 degrees east with a 2-foot branch vein striking north 30 degrees east. The open-cuts on the Tipperary claim expose one vein 2 feet wide striking south 30 degrees east and a dozen or more veins of the transverse type striking north 15 to 35 degrees east, one or two of which are 1 foot wide.

The cuts extend southeast through the Kitchener claim and expose one bed vein and at least six veins striking north 60 to 85 degrees east and dipping steeply south. These veins vary from 8 inches to 2 feet in width. One trench near the southeast boundary of the claim exposes a small body of quartz-porphyry.

The workings extend southeast through the adjoining Independence claim. At the boundary between the Kitchener and Independence claims a bed vein and a diagonal vein are exposed, both about 6 feet wide and well mineralized, locally at least, with pyrite. The bed vein also contains considerable siderite. A few hundred feet northeast on the same boundary two shafts supplement the open-cuts and expose several veins, mainly of the bed vein type. The Bell adit, 700 feet long, has been driven southwest under the shafts and also under the bed and diagonal vein farther southwest. An 8-foot bed vein near the face of the adit is presumably the same bed vein that is exposed on the surface. Under the

shafts another bed vein was encountered, locally 8 feet wide. Both veins are well mineralized with pyrite and picked samples of pyrite have assayed 4 ounces of gold a ton. Two shafts and the Newberry adit have been driven amid open-cuts near the southwest boundary of the Independence claim. The shafts and open-cuts disclose a diagonal vein and also bed veins several feet wide well mineralized with pyrite and galena. The Newberry adit, 600 feet long, was driven west under the two shafts. It cuts two wide quartzose zones, each about 30 feet wide, of the bed vein type, locally well mineralized with pyrite.

Scattered open-cuts continue southeast into the adjoining Hard Cash claim which extends down to Grouse creek. The Syndicate has begun another adit on this claim, called the 400 adit, to explore their ground at depth. There are three other old short adits on the Hard Cash claim, the Anderson in the centre of the claim and the Moore and Fountain Head adits near Grouse creek. The Moore and Anderson adits fail to disclose veins of commercial width. The Fountain Head adit, however, cuts a 30-foot bed vein consisting of quartz banded with country rock, and also at least two branch veins a foot wide, striking north 65 degrees east, consisting of quartz and pyrite.

Sampling has not been thorough enough to set an average assay value on the veins, but has shown that some veins locally will assay an ounce of gold a ton across a width of 2 feet.

The rocks southwest of the claims are mainly unsheared dark grey quartzites and those northeast of the claims are fissile quartzites of the Baker member, and above these is the Barkerville formation. The intervening ground, covered by the claims, apparently absorbed much of the regional stress and yielded by shearing and by fracturing. The Baker member took up some of the stress and yielded mainly by shearing.

ADDENDA

Several mineral deposits were visited that lay outside of the Barkerville gold belt. Descriptions of these do not properly belong with a report on the gold belt, but as no geological report is being written at present on Willow River map-area, a geological map of which is now being prepared, it is desirable to present some information on the mineral deposits of this map-area. Brief descriptions of the mineral deposits seen in Willow River map-area but not included in the Barkerville gold belt will now be given. The properties are taken up in alphabetical order.

BARRY CREEK GROUPS

Barry creek enters Willow river from the west about 12 miles north of Beaver Pass House. There are three groups of claims at this place, the Ajax, Rex, and Lux groups, held in 1933 by N. Hanson and partners. The Beaver Pass trail is the route to the properties.

Only a few isolated rock outcrops were seen. They are of grey, quartz-sericite schists and calcareous schists of the Cariboo series, striking west to west-southwest and dipping north at moderate to steep angles. The location is on the northeastern limb of the main anticline of the Cariboo series about 2 miles from its crest.

The mineral showings consist of narrow quartz stringers exposed in Barry creek and striking in the main northeast, and of larger bodies of quartz a few hundred feet above the crossing of the Beaver Pass trail. The quartz stringers are reported to contain some free gold. Some of the larger bodies of quartz are boulders, probably near their source, but two may be in place. One of these is 3 feet wide and 20 feet long, strikes northwest, and dips 60 degrees northeast. It consists of white quartz sparingly mineralized with pyrite and containing some sericite. The other is 6 by 8 feet and appears to strike northeast and dip 60 degrees northwest. This body is also very sparingly mineralized with pyrite.

BURNS MOUNTAIN GOLD QUARTZ MINES, LIMITED

The property of the Burns Mountain Gold Quartz Mines, Limited, is the old Perkins group, at an elevation of 5,200 feet on Burns mountain about 2 miles east of Stanley.

The rocks on the property are sheared quartzites and quartz sericite schists of the Cariboo series, striking northwest and dipping gently northeast. On a hillside sloping gently to the west, pits, shafts, and trenches were made many years ago on three parallel quartz veins, each about a foot wide, that are 25 feet apart and strike north-northeast and dip steeply west. The veins were followed on the surface for 200 feet or more along their strike. Seventy-five feet lower an adit was driven eastward toward these veins and a raise put up to the surface. Gold ore was mined from the

veins. In 1933 the company continued the adit, but encountered only narrow quartz stringers. These stringers strike north-northeast and dip 70 degrees west. Cube pyrite is very plentiful in the rocks near the veins.

About 1,500 feet north are other old workings tracing a quartz vein uphill for a distance of 500 feet. The lower part of this vein strikes east-northeast and the upper part north-northeast. This vein, also, was mined, but no recent work has been done on it.

About 500 feet east of the camp is a quartz-ankerite vein, 1 to 3 feet wide, striking northeast. The ankerite appears to occur chiefly near the walls of the vein.

About 2,000 feet southeast and 300 feet below the camp, the company drove a crosscut adit northwest. This tunnel is 1,370 feet long, and cuts several narrow, northeasterly striking quartz stringers.

Mining on a small scale was carried on at the property for several years after 1878. Good ore is reported to have assayed $30 to $120 in gold.

CANADA GOLD LODE MINING COMPANY

Four groups of claims were being prospected in the summer of 1933 for the Canada Gold Lode Mining Company. These groups are the Eagle Mountain Gold Quartz, Dragon Mountain Gold Quartz, Jawbone Gold Quartz, and Tiger Gold Quartz. The properties are north of the Barkerville road 2 to 4 miles east of Beaver Pass House.

The country rock is mainly quartz-sericite schist of the Cariboo series striking northwest to northeast and dipping at various angles to the west. The location is approximately on the crest of the main anticline of the Cariboo series.

At an elevation of 4,800 feet on the east side of Timon creek, two open-cuts, 100 feet apart on the Eagle Mountain Gold Quartz group, expose a 2-foot quartz vein striking northeast, dipping 45 degrees northwest, and lying parallel to the shear planes of the rocks. The quartz contains some pyrite and sericite. Low assays in gold are reported. Another open-cut, 150 feet away, discloses another body of quartz 3 feet wide and 8 feet long containing some pyrite and sericite.

On the west side of Timon creek, on the Dragon Mountain Gold Quartz group, an open-cut at an elevation of 4,200 feet exposes a vertical quartz vein varying in width up to 2 feet and striking east. It is parallel, or nearly so, with the shear planes of the rock and contains some pyrite and sericite. Another open-cut, 200 feet higher and about ¼ mile farther north, exposes another 2-foot quartz vein striking east and containing some sericite.

At an elevation of 3,900 feet on the east branch of Jawbone creek, on the Jawbone Gold Quartz group, a short adit exposes a quartz vein varying in width up to 6 feet. The rock and vein are so shattered that neither the strike of the rock nor that of the vein could be determined accurately. The vein appears to strike east and to dip gently south. The quartz is mineralized with some pyrite and a little galena.

At an elevation of 3,800 feet, ½ mile west of Jawbone creek, a short adit on the Tiger Gold Quartz group exposes a quartz vein 3 feet or more

wide striking north 10 degrees west, dipping 30 degrees west, and lying in sheared quartzite with approximately the same strike and dip. The vein is locally split into several veins. The quartz is mineralized with some pyrite and galena.

CANYON AND TYEE GROUPS

The Canyon and Tyee groups of claims are held by A. Drinkwater and associates. The Canyon group is on Sugar creek below Little Mustang creek, and the Tyee group is about 2 miles west. Access is via the Sugar Creek trail, and the distance is about 12 miles northwest of the Barkerville road at the foot of Jack of Clubs lake. A short branch trail from Little Mustang creek leads to the Tyee group.

On the Canyon group many quartz veins are exposed on the banks of Sugar creek, either naturally or in open-cuts. They occur in rocks striking west-northwest and dipping about 40 degrees north. No vein has been traced for over 100 feet, and all are very sparsely mineralized with pyrite. Most of the veins are parallel to the strike of the enclosing rocks, but some strike north-northeast. Low values in gold are reported.

The showing on the Tyee group is a body of quartz 20 feet by 50 feet, containing some pyrite, galena, sericite, and inclusions of argillaceous schist. A small outcrop of argillaceous schist near the vein strikes west-northwest and dips 40 degrees north. The quartz body appears to strike northeast and dip 60 degrees northwest, but a cover of drift obscures relationships and it is not even certain that the quartz is in place. Low values in gold are reported.

CARIBOO CORONADO MINING SYNDICATE

In 1934 the Cariboo Coronado Mining Syndicate carried on surface and underground exploration on its holdings northeast of Willow river opposite Island mountain.

The country rock consists of limestone and schist of the Barkerville formation and of argillite and quartz-sericite schist of the overlying Pleasant Valley formation.

An adit was driven north 13 degrees west for 1,150 feet (August, 1934) into the mountain southeast of Martin creek to cut veins exposed on the surface 500 to 800 feet higher. The objectives were not reached, but the adit cut several quartz veins a few inches to 2 feet wide and several bands of calcareous argillite and of green schist partly replaced by pyrite.

Another adit was driven north 14 degrees west for 385 feet into the mountain northwest of Martin creek. This adit cut several narrow quartz veins and many quartz gashes and stringers of irregular shape. Some of the quartz is well mineralized with pyrite. A band of replacement ore 2 inches wide cut by the adit assayed $6 a ton in gold. Open-cuts and a shaft on the mountain top expose several quartz veins a few inches to 8 feet wide mineralized with galena and pyrite. The veins strike north 30 degrees east to east. Picked samples have assayed more than half an ounce of gold a ton. The veins are mostly in argillaceous and sericitic schists, but one is in a body of undefined shape of quartz porphyry.

COMSTOCK GROUP

The Comstock or Big Twelve group adjoins the Tyee group on the north, and is about 12 miles northwest of the Barkerville road at the foot of Jack of Clubs lake. Access is provided by the Sugar Creek trail and a short trail from Little Mustang creek. The owners are Messrs. Sparling, Riley, and others of Barkerville.

The country rocks are sheared quartzites and conglomerates, probably of the Cariboo series, striking west-southwest to west-northwest and dipping about 40 degrees north. Three groups of veins are exposed in open-cuts, shafts, and tunnels.

A vein 18 inches wide is exposed in open-cuts and strikes east and dips 70 degrees south. This vein cuts across the strata making a small angle with their strike and a large angle with their dip. It has been traced for 100 feet. The western open-cuts disclose four narrow veins, indicating that the 18-inch vein either splits to the west or that other parallel veins begin there. About 100 feet north an incline shaft 10 feet or more deep exposes a 4-foot quartz vein striking northwest, dipping 45 degrees northeast, and lying parallel to the strata. About 100 feet farther north a 50-foot adit driven southeast cuts a body of quartz 8 feet or more wide. This vein appears to strike west-northwest parallel with the strike of the rock. An open-cut 200 feet northwest exposes vein quartz that may belong to this vein. The veins are sparsely mineralized with pyrite and galena and contain some sericite. Low values in gold are reported.

FOSTER LEDGE GOLD MINES, LIMITED

The property of the Foster Ledge Gold Mines, Limited, consists of the old Foster group and other claims on Chisholm creek about 2 miles north of Stanley.

The country rock consists of sericite and argillaceous schists of the Cariboo series, striking north and dipping 30 degrees east. Several narrow quartz veins striking north or slightly east of north and dipping 70 degrees west are exposed on the banks of Chisholm creek. The veins have been traced for about 100 feet and contain pyrite, galena, sphalerite, and free gold. At this locality an old shaft on Chisholm creek is reported to be 56 feet deep and to have been sunk on two 5-foot veins 4 feet apart. It is reported that samples from the shaft have assayed $700 a ton in gold. About 400 feet south of the shaft, and about 100 feet lower, an adit has been driven 315 feet north. It cuts several narrow quartz veins. Another vein a foot wide, striking northeast and dipping 75 degrees northwest, is exposed 1,800 feet southeast of the shaft. A crosscut adit has been started eastward from Chisholm creek to cut this vein at a depth of 200 feet. It is 200 feet long and will reach the projected position of the vein in another 300 feet. Open-cuts 2,400 feet southwest of the shaft expose one or more quartz veins 2 feet wide striking north 25 degrees east and well mineralized with galena.

NORTH STAR GROUP

The North Star group of claims is on Cooper creek, a short stream entering Sugar creek from the southwest. Cooper creek is 10 to 11 miles

from the Barkerville road at the foot of Jack of Clubs lake via the Sugar Creek trail. The claims were explored in 1933, by means of open-cuts, by the Premier Gold Mining Company, Limited.

Country rock consists of sheared quartzite and argillite of the Cariboo series, striking northwest and dipping 20 to 70 degrees northeast. The veins range in width from a few inches to 30 feet. Some of the narrower veins are locally well mineralized with pyrite, galena, and pyrrhotite. Some contain sericite and one or two contain a little chalcopyrite. Low values in gold are reported, particularly from the veins that are mineralized with sulphides, but no commercial gold ore has yet been found. None of the veins has been explored to a depth greater than 10 feet.

Some of the veins are parallel to the strike and dip of the country rock, others are parallel to the strike but dip in the opposite direction, and many crosscut the rocks at various angles to both strike and dip. One or two of the crosscutting veins appear to cut veins paralleling the rocks, but this point could not be established conclusively.

Most of the veins are on the east side of Cooper creek, and no vein has been traced across the creek. This suggests that a fault strikes northeast along Cooper creek. Geological work farther northeast along Sugar creek also suggests such a fault and that the northwestern fault block is offset to the southwest.

RICHFIELD CARIBOO GOLD MINES, LIMITED

The holdings of the Richfield Cariboo Gold Mines, Limited, consist of many mineral claims southeast of Mink gulch, a few miles south of Barkerville.

The following report is based on information collected during a brief visit to the property in 1934. The owners were not in the district at the time the property was examined, and as the writer did not sample the showings he has no knowledge of assay values.

The surface showings seen were on the Eldorado No. 4 fraction and the Eldorado No. 2 claims on the northern slope of the mountain between Mink gulch and Williams creek, and consisted of quartz veins in massive grey quartzite of the Richfield formation. An adit 1,500 feet long has been driven from Mink gulch south toward the surface showings from a point 700 feet below and 2,500 feet north of them.

The lowest open-cut at an elevation of 5,850 feet on the Eldorado No. 4 fraction claim is a large one exposing four quartz veins. One is 8 feet wide, strikes south 70 degrees east, and dips 70 degrees north. Another is 2 feet wide and strikes north 75 degrees east, and the other two are 2 and 4 feet wide and strike south 75 degrees east. About 300 feet farther southeast on the Eldorado No. 2 claim another open-cut exposes a 7-foot quartz vein striking south 80 degrees east. Southeast of this at about 50-foot intervals are eight other quartz veins whose widths range from 3 to 10 feet and whose strikes vary from north 85 degrees east to south 60 degrees east. The veins consist of quartz with very little sulphide.

The adit has been driven south through gently dipping argillite. Several bed veins 2 to 3 feet wide were cut in the first 900 feet of the adit.

Some contain a little pyrite and ankerite and the adjacent argillites commonly contain many narrow streaks of pyrite. From 900 to 1,400 feet from the portal the adit follows closely a slightly faulted, gently dipping sill of quartz porphyry. The sill is commonly 3 to 5 feet thick, but narrows to 2 feet and widens to more than 7 feet locally. It contains a great deal of quartz in irregular veinlets and in gash veins striking east and dipping approximately vertically. The gash veins are a few inches to 2 feet wide and are so numerous that 50 feet of adit cuts ten to twenty of them. Most of them taper to end at the top and bottom of the sill but a few extend a few inches to a couple of feet beyond the sill boundary. The intruded rock at the edges of the sill and many of the veins in the sill contain pyrite. The mode of occurrence of the quartz and the pyrite strongly suggests that they were derived from the sill.

INDEX

	Page
A veins, description	1, 13
Origin	14
Ajax group	34
Alder fraction	30
Anderson adit	33
Anticlines	1–3, 7
Area mapped, description	1
B veins, described	1, 13
Origin	14
Baker member, description	4, 5, 7, 17
Ore possibilities	16
Veins in	10
Barkerville formation, description	2, 4
Barkerville gold belt, description	1
Geology	3
Barkerville mt	26
Basal member, description	4, 7, 17
Veins	10
Barry creek	34
Barry Creek groups, description	34
B.C. member, description	4, 6
Veins	10, 17
B.C. vein, description	11, 25
Bed veins, character, mineralization	12, 13
Occurrence	30
Origin	14, 15
Bell adit	32
Big Twelve group	37
Black Bull claims	25
Black Jack claim	29
Black Jack gulch	30
Black Jack Extension claim	29
Blighty claim	32
Bonita claim	30
Bowman, E., rept. cited	1
Britannia Mining and Smelting Co., mining by	28, 29
Burns mt	34
Burns Mountain Gold Quartz Mines, Ltd	34
Canada Gold Lode Mining Co	35
Canyon group	36
Cariboo claim, description	11, 25
Cariboo claim (Barkerville mt.)	26
Cariboo series, age, description	1, 2
Cariboo-Amalgamated Gold Mines, Ltd	30
Cariboo Central Gold Mines, Ltd	25
Cariboo Coronado Mining Syndicate	36
Cariboo Gold Quartz mine	
Description	22–25
Ore-body	14, 16
Rocks	4, 5
Veins	10, 11, 17
Cariboo Gold Quartz Mining Co., Ltd	22–25
Cariboo No. 1 claim	24
Champion claim	25
Chisholm creek	37
Comstock group	37
Conklin claim	5, 31
Cooper creek	37
Cornish claim	30
Cosalite	24
Cow mt	22
Diagonal veins	11, 12, 17, 23
Diller claim	29
Dooley ledge	28
Dragon Mountain Gold Quartz group	35
Drinkwater, A	36
Eagle Mountain Gold Quartz group	35
Eldorado No. 2 claim	38
Eldorado No. 4 claim	38
Evening Star claim	27
Faults	3, 8, 9, 19
Field work in area	1
Foster Ledge Gold Mines, Ltd	37
Fountain Head adit	33
Free Gold claim	30
Galenobismutite	24
Geology, economic	19–39
See also Ore deposits	
Geology, general	3–7
Geology, regional	1–3
Geology, structural	7
Gold, area of concentration	7, 16
Nuggets	24
See also Lode gold	
Grouse fault	8
Hanson, N	34
Hard Cash claim	33
Home Rule ledge	28
Island mt	3, 19
Island Mountain fault	8
Island Mountain mine, description	19–22
Ore-bodies	4, 13
Rocks	5
Veins	10
Independence claim	32
Jawbone creek	35
Jawbone Gold Quartz group	35
Jurassic. *See* Quesnel River group	
Kitchener claim	32
Lay, Douglas, rept. cited	1
Liberty claim	30
Limestone	2
Fracturing in	9
Replacement in	4, 18, 19

PAGE
Lode gold, occurrences of..... 1
See also Individual deposits
Lowhee creek, claims on..... 25
Lowhee fault..... 8
Lowhee member, description.....4, 6, 17
Veins. 10
Lux group..... 34
Mammoth claim..... 30
Marie claim..... 26
Martha claim..... 26
Martin creek..... 36
Mineralization, origin and mode... 14–16
Mink gulch..... 38
Mint claim..... 30
Moore adit..... 33
Morning Star claim..... 27
Mucho Oro claim..... 27
Myrtle claim..... 6, 26
Newberry adit..... 33
N. M. No. 3 fraction..... 28
Ore deposits, mineralization of..... 9–14
Origin of..... 14–16
Types. 9, 17
Origin of deposits..... 14–16
Penelope claim..... 31
Perkins group..... 34
Pilot claims..... 30
Pinkerton and Goldfinch claims.... 24
Pleasant Valley formation..... 2
Precambrian. *See* Cariboo series
Premier Gold Mining Co., Ltd..... 38
Progress claim..... 28
Progress No. 7 claim..... 28
Progress No. 8 claim..... 28
Proserpine claim..... 31
Proserpine intrusives..... 2
Proserpine East claim..... 31, 32
Proserpine South claims..... 31
Proserpine Syndicate..... 32
Prospecting, favourable ground for. 16–18
Methods. 18
Pyrite. 12, 16
Quartz pyrite veins..... 28
Quartz veins, description and types. 3, 8–13, 17
See also A and B veins

PAGE
Quartzites. 2, 9
Quesnel River group..... 2
Rainbow fault..... 8
Rainbow member, description.....4–6, 17
Faults, fractures..... 8, 18
Ore possibilities..... 17, 18
Veins in.....10, 18, 19, 22
Replacement deposits, description and occurrence.. ...4, 13, 16–18, 20, 23
Rex group..... 34
Richfield formation..... 2
Richfield Cariboo Gold Mines, Ltd. 38
Round Top mt..... 1
Royal Oak claim..... 30
Sanders vein zone..... 11, 24
Shamrock claim..... 28
Shamrock Gold Mines, Ltd..... 28
Sirius claim..... 29
Slide Mountain series..... 2
Sparling, Riley, Messrs..... 37
Steadman ledge..... 30
Stouts gulch, claims on..... 27, 28
Strike fault veins, character, mineralization. 12, 13, 17, 23
Sugar creek..... 1, 36
Tiger Gold Quartz group..... 35
Timon creek..... 35
Tipperary claim..... 32
Transverse veins, description, mineralization. 10–12, 17, 30
Tyee group..... 36
Uglow, W. L., rept. cited....1, 9, 13, 14, 30
Veins
Origin. 14, 15
Types. 9–13, 17, 18
Walker gulch..... 30
Warspite claim..... 32
Wells vein..... 24
Westport claim..... 29
Wilkinson claim..... 31
Williams creek, claims on..... 29, 30
Willow river..... 36
Willow River map-area, mapping in. 1
Wintrip claim..... 28