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PRELIMINARY REPORT

KEITHLEY CREEK MAP-AREA, CARIBOO DISTRICT, BRITISH COLUMBIA

By

A.H. LANG

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PAPER 38-16

APRIL 1938

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KEITHLEY CREEK MAP-AREA, CARIBOO DISTRICT, BRITISH COLUMBIA

By A.H. Lang

INTRODUCTION

Keithley Creek map-area (latitudes $52^{\circ}45'$ to $53^{\circ}00'$, longitudes $121^{\circ}00'$ to $121^{\circ}30'$) is in the southeastern part of Cariboo District, its northern boundary being about 5 miles south of Barkerville and its southern boundary about 16 miles north of Quesnel Lake. The area has yielded an important production of placer gold, and placer mining on a restricted scale continues at present. Interest in the numerous quartz veins of the area was revived recently by the successful operation of the Cariboo Gold Quartz and Island Mountain mines near Barkerville, and several quartz properties are now being tested.

During 1885 and 1886 Amos Bowman¹ made a geological reconnaissance of a large region of which Keithley Creek area is a part. At the same time Bowman prepared maps of the principal auriferous creeks, including Keithley, Harveys, Antler, and Cunningham Creeks in Keithley Creek area. These maps provide valuable information regarding the position and extent of the early placer workings.

In 1922 W.L. Uglow mapped the bedrock geology of Barkerville map-area, which overlaps the northwestern corner of Keithley Creek area by a few square miles, and in 1922 and 1923 W.A. Johnston made a detailed study of the placer deposits of Barkerville area, including those on Antler and Cunningham Creeks in Keithley Creek area.²

In 1934 George Hanson³ made a detailed investigation of the Barkerville Gold Belt between Island Mountain and Grouse Creek. This work extended to a point 3 miles north of Keithley Creek area.

The present report is based on field work done in 1935 and 1936, and during one month in 1937.

¹Report on the Geology of the Mining District of Cariboo, British Columbia; Geol. Surv., Canada, Ann. Rept. vol. III, pt. I, Pt. C.

²Placer and Vein Gold Deposits of Barkerville, Cariboo District, British Columbia; Geol. Surv., Canada, Mem. 149 (1926).

³Barkerville Gold Belt, Cariboo District, British Columbia; Geol. Surv., Canada, Mem. 181 (1935).

GENERAL CHARACTER OF THE DISTRICT

Keithley Creek area is part of a semi-mountainous belt that forms a transitional zone between the interior plateaux and Cariboo Mountains proper, which rise to heights of 8,000 to 10,000 feet immediately east of the map-area. The highest point in the map-area, in the extreme southeast corner, is one of a trio of peaks known as the Three Ladies, 7,171 feet in elevation. The lowest point is Cariboo Lake, which has a surface elevation of 2,650 feet. The summits in Keithley Creek area, most of which are between 5,500 and 6,800 feet above sea-level, are remnants of an ancient, uplifted erosion surface that slopes gently westward, so that the summits in the eastern part of the area have average elevations slightly higher than those of the western part. The present sub-alpine to alpine nature of the topography is the result of stream erosion during Tertiary time, followed by glaciation, which has dissected the old plateau surface into numerous irregular-shaped segments. Alpine glaciers have formed many small cirques at high elevations, particularly on the northern slopes. The larger valleys are U-shaped because of valley glaciation, and are floored by unknown thicknesses of alluvium and glacial drift upon which the present streams meander. Post-glacial uplift caused the streams to cut deep rock canyons where bedrock was near the surface, the chief examples being the canyons of Cariboo and Matthew Rivers and Antler, Cunningham, and Kimball Creeks.

Timber-line is at approximately 6,000 feet, so that the higher summits are easily travelled. The slopes and valleys are heavily wooded with spruce, balsam, jack pine, and poplar. The amount of fallen timber combined with the undergrowth of willow, alder, and devil's club in the valleys and the dense buck-brush on most of the slopes greatly obstruct travel below timber-line. Much of the region drained by Kimball Creek and the north branch of Little River has been swept by fire, and here travel is comparatively easy.

The area lies in a belt of heavy precipitation where the winters are long and the summers cool and wet. Some snow lies on the uplands until June, and snow falls there occasionally during the summer months.

Accessibility

The northern part of Keithley Creek area is reached by a road from Barkerville, which enters the area at Whisky Flat, 7 miles from Barkerville. Here the road branches, one branch extending 4 miles up Antler Creek to Sawmill Flat, the other

continuing through Cunningham Pass and up Cunningham Creek about a mile above the Trohouse hydraulic camp, a total distance of about 12 miles from Barkorville. From this point a tractor road extends about 6 miles up Cunningham Creek to the Cariboo Hudson mine.

The southern part of the area is reached by a road 62 miles long, which leaves the Cariboo highway at the 158 mile house and terminates at Keithley Creek village in the southwestern corner of the map-area. From the village a road extends about $2\frac{1}{2}$ miles up Keithley Creek to the Placer Engineers camp.

The part of the map-area lying west of Cariboo River and north of Cariboo Lake, which includes the part of the area most favourable for prospecting, is fairly well supplied with trails over which pack-horses can travel in summer. The other half of the area, being frequented only by a few trappers in winter, was found to be devoid of passable trails. The writer's party cut or cleared out about 40 miles of rough trail in order to get pack-horses to base camps in this part of the area, which is thus rendered more accessible for prospecting.

Cariboo Lake and Cariboo River provide a good water route as far as the mouth of Harveys Creek, and this route is used in transporting supplies for the placer camps at Nigger and Harveys Creeks. The distance from the landing near Keithley Creek to Nigger Creek is $4\frac{1}{2}$ miles, to the head of the lake $5\frac{1}{2}$ miles, and to the Harveys Creek landing $8\frac{1}{2}$ miles. Cariboo River is navigable for small boats as far as the falls, a distance of about 24 miles from Keithley Creek, but the current is fairly swift. The banks are too steep and wooded for lining, except in a few places, but the river can be poled by experienced men. The swiftest water is near the mouths of Kimball and Six Mile Creeks.

GENERAL GEOLOGY

Keithley Creek area is underlain by a great thickness of sedimentary rocks of different types and ages, folded into a broad anticlinorium in the western part of the area and a synclinorium in the eastern part. The oldest strata are exposed along the eroded anticlinal axis and the youngest are now found only in the synclinal trough. The beds and the axes of the folds have a general northwesterly strike, parallel to the trend of the mountain ranges and the axes of the main folds plunge northwesterly. The Cariboo series, believed to be mainly at least of late Precambrian age, consists of altered sediments estimated to be 15,000 feet thick. On Kimball mountain these beds are overlain with apparent conformity by Lower Cambrian strata, which, in turn, are overlain

unconformably by Permian or, possibly, Carboniferous strata consisting chiefly of limestone and argillite. These are overlain at one locality by a small body of conglomerate believed to be of Mesozoic age.

Large igneous bodies are scarce, but dykes and small intrusive masses are numerous and increase in number toward the southeast. A few acidic sills and dykes found only in the Cariboo series are believed to be pre-Carboniferous in age. A granitic stock and smaller intrusives ranging from diorite to amphibolite are probably Mesozoic.

Tertiary deposits, consisting of sand, gravel, and talus, are rarely exposed, but probably underlie some of the younger accumulations of overburden. Deposits of boulder clay, morainal material, stratified sand, silt, and gravel, of Pleistocene age, mantle most of the bedrock surface; and Recent stream gravels, sands, and silts floor the larger valleys. Bedrock is well exposed on some of the summits and in canyons, but elsewhere the overburden seriously hinders prospecting and detailed geological mapping.

Cariboo Series

In Barkerville area the Cariboo series has been divided into three conformable formations which, in ascending order, are: the Richfield, consisting essentially of impure quartzite and schist; the Barkerville, consisting essentially of limestone; and the Pleasant Valley, consisting essentially of argillite. These formations extend into Keithley Creek area, but limestone becomes increasingly abundant in the Pleasant Valley and the upper part of the Richfield, so that the formational subdivision is less clearly defined. The top and base of the Barkerville have been placed where limestone ceases to be the most abundant constituent. The Richfield formation is particularly important because it contains almost all of the gold discoveries in Barkerville and Keithley Creek areas.

A thick succession of beds in the northeastern part of the area, on the northeast limb of the synclinorium, has been grouped with the Cariboo series because the strata yielded no fossils and resemble lithologically some of the rocks of the Richfield and Pleasant Valley formations. This assemblage of strata has been divided into three apparently conformable formations, the Ishpa, Matthew, and Kimball formations. The stratigraphic successions in the eastern and western parts of the area do not correspond sufficiently to permit the use of the names "Richfield", "Barkerville", and "Pleasant Valley", but it

may be possible to correlate these strata at some future date, when the structures east of the area have been mapped. At the east end of Kimball ridge the rocks are poorly exposed, no horizon-marking bed being found that would permit correlating the strata at either side of the inferred continuation of a fault that has been adopted as the line of demarcation between the two parts of the Cariboo series.

The discovery on Kimball ridge of beds containing many Lower Cambrian fossils furnishes important information regarding the age of the Cariboo series. In Keithley Creek area no evidence of an angular unconformity or conglomerate was found either at the base of the Lower Cambrian fossiliferous strata or within the beds mapped as the upper part of the Cariboo series. It is possible that there is a slight discordance for which the evidence has been destroyed by the subsequent folding and shearing of the strata. The upper beds included in the Cariboo series in Keithley Creek area may be Lower Cambrian, but probably at least the Richfield and Barkerville formations are Precambrian.

Richfield Formation

The Richfield is the lowest formation of the Cariboo series and underlies the western half and southern part of the map-area. The impure, clastic sediments of the Richfield formation exhibit all degrees of shearing and alteration, from massive unsheared quartzite to soft, quartz-sericite schist. Interbeds of argillite, relatively pure quartzite, and limestone are common, and beds of graphitic schist and conglomerate occur in places. Some of the beds are lenticular, and some may change in character along the strike, consequently sections at different positions along a given horizon do not always correspond. Admixture of quartzose, limy and argillaceous material has produced argillaceous quartzite, calcareous quartzite, and argillaceous limestone. Individual beds are from a fraction of an inch to 100 feet or more in thickness.

The impure quartzites are light to dark grey, brownish, greenish, or black, and are commonly rusty weathering. They vary from fine-grained types containing granulated and interlocking quartz grains from 0.03 to 1.0 mm. in diameter, to coarse, recrystallized grits containing quartz fragments up to 1 cm. in diameter. The gritty types, which occur principally within a few miles of Yanks Peak, have a pseudo-porphyrritic appearance that leads many prospectors to regard them as intrusives, but all such rocks examined microscopically consist of an interlocking mosaic of recrystallized quartz grains, without feldspar or, at most, a

few grains of feldspar such as would occur in arkosic sediments, the rocks unquestionably being altered sediments. Impurities occurring in different rock types and constituting up to about one-quarter of the rocks are sericite, biotite, chlorite, talc, fine-grained argillaceous material, pyrite, calcite, siderite, and limonite. The impure quartzose rocks are rarely completely massive, but some types possess only slight cleavage. Fissile types with well-developed slaty cleavage marked by partings of parallel flakes of sericite or biotite are common, and include types termed quartz slates by Uglow. More intense deformation has produced foliation or schistosity in the more micaceous rocks, the end product of deformation in most cases being quartz-mica schist, and, more rarely, chlorite schist and sericite schist containing little or no quartz. Some fissile and schistose quartzites contain large quantities of calcite.

The purer quartzite are white to light grey and are either very massive or distinctly laminated. Being dense and hard, these quartzites are very resistant to erosion. Many beds consist only of interlocking grains of recrystallized quartz, averaging 0.2 to 0.5 mm. in diameter, commonly exhibiting strain shadows microscopically. Others contain very minor quantities of sericite and pyrite, those containing pyrite being slightly rusty weathering on fracture planes. The summit of Yanks Peak is composed of extremely hard, light grey quartzite that as a result of weathering breaks into large, angular joint blocks. This rock is traversed by minute quartz stringers, some of which grade into the rock. Microscopic examination shows an interlocking mosaic of quartz, but does not prove whether the rock resulted from recrystallization of a pure quartzose deposit or from replacement by siliceous solutions. The latter explanation is at least plausible because of the gradation of the stringers and because the rock could not be traced north or south of Yanks Peak.

The argillites, which were originally shales, are commonly fissile or schistose. Most of the rocks are black, but some types are dark grey or brown. Some types contain much graphite. The beds vary from thin argillaceous partings in limestone and quartzite to strata many feet thick, in which the bedding planes have in most cases been destroyed by shearing.

Limestone occurs in beds and lenses from a fraction of an inch to 150 feet thick. These rocks vary in colour from white to dark grey, bluish, and buff. They are commonly mottled, and contain veinlets of calcite in fractures. Many beds have been recrystallized to form marble. Minute drag-folds may be seen in places and are probably common, but masked by recrystallization in

the more homogeneous beds. Beds of black impure limestone contain abundant argillaceous material.

The upper part of the Richfield formation in Barkerville area was mapped in detail by Hanson¹ between Island Mountain and

¹Hanson, G.: Barkerville Gold Belt, Cariboo District, British Columbia; Geol. Surv., Canada, Mem. 181, pp. 3-9 (1935).

Grouse Creek, and the corresponding part of the formation between Antler Mountain and Harveys Creek was studied carefully by the writer in an effort to determine whether the relationships found in Barkerville area continue into Keithley Creek area.

Rock exposures are fairly numerous along the banks of upper Antler Creek between Sawmill Flat and Cunningham Pass. Impure quartzites and schists are exposed for a horizontal width of about 3,000 feet between Sawmill Flat and the mouth of Victorian (Victoria) Creek. Limestone beds intercalated in beds of fissile quartzite and schist occur for approximately 1,000 feet northeast of Victorian (Victoria) Creek. These are succeeded by a thick assemblage of fissile, impure quartzites, quartz-sericite schists, and buff-coloured, gritty quartzites, extending for a surface width of about 5,000 feet. About midway between Glass and McNeill Creeks the last-named beds are overlain by interbedded limestone and calcareous argillite, extending for about 3,000 feet to the mouth of McBean Creek. These are overlain by black and brown argillites and argillaceous schists that are calcareous in places, extending for about 4,500 feet to Whisky Flat, where they are succeeded by the Barkerville limestone in Cunningham Pass. Some of the quartzite and argillite resembles sediments of the Barkerville Gold Belt, but the succession at Antler Creek clearly differs from that at Grouse Creek.

The upper part of the Richfield formation can be divided into members between the west fork of Cunningham Creek and the headwaters of Simlock Creek, although the boundaries between the members cannot be mapped precisely because of incomplete exposures. Scattered outcrops northwest and southeast of the region thus subdivided indicate that these members probably extend, with some variations, from Antler Creek and Cunningham Pass to Cariboo River, but sufficient exposures could not be found to justify the extension of the geological boundaries.

Immediately northwest of the summits of Roundtop and Middle Mountains the beds underlying the massive limestone of the Barkerville formation consist of massive to fissile argillites,

black to dark grey, with some green, schistose argillite and a few narrow beds of fairly pure quartzite. These strata, outcropping for widths of 1,000 to 2,500 feet, are termed the Lostway member. Similar argillites underlie the Barkerville formation from Lostway Creek, at the northern boundary of the map-area, to Cariboo River, but the base of the member can be mapped approximately only for a distance of about 4 miles.

The Lostway member is underlain by hard, white, massive and fissile quartzite, classed as the Roundtop member. This member is best exposed on the summits of Roundtop, Middle, and Fiva Mountains, where it outcrops for widths of 1,500 to 2,800 feet. The same beds occur along the summit of the ridge northwest of Roundtop Mountain, as far as Cunningham Pass, their position and strike indicating that the members of the upper Richfield, as well as the Barkerville formation, have been displaced by faulting. The boundaries of the Roundtop member can be mapped only near Roundtop and Middle Mountains.

The Roundtop member is underlain by black, fissile argillite, termed the Bee member, which outcrops for a width of about 1,000 feet on the west slope of Roundtop Mountain, and for about 4,000 feet on the west and south slopes of Middle Mountain, the width of exposure being due partly to the topography. Similar argillite occurs on the ridge northwest of Roundtop; on the north end of Nugget Mountain; and is particularly well exposed in the bed of Cunningham Creek near the end of the Barkerville road and in the adit on W.E. Thompson's claims west of Cunningham Creek. The boundaries of the member have been mapped only between Roundtop and Bee Mountains.

For a distance of about 2 miles southwest of the Bee member the strata include much limestone interbedded with sheared, impure quartzite, schist, and some argillite. Occurrences of limestone elsewhere in the Richfield formation are insignificant in comparison with the abundance of limestone in this belt, which is termed the Hudson member. This might well be divided into three members, if exposures permitted drawing boundaries between them, as the belt consists of an upper part immediately underlying the Bee member, in which limestone is very abundant; a central part consisting of fissile and schistose, impure quartzite and schist, with some argillite and fairly massive quartzite, but very little limestone; and a basal part consisting of quartzite, schist, and argillite with considerable limestone; below which are the remaining, unsubdivided beds of the Richfield formation. The limestone beds of the upper part of the Hudson member, which are up to 150 feet thick, are best exposed near the head of Craze Creek, in the upper part of Penny Creek, on the Bralco claims, and on the ridge extending southwest from Bee Mountain. The altered

quartzose sediments forming the central part of the member occur near the mouth of Peter Gulch Creek, in the lower part of Penny Creek, and on the Cariboo-Hudson claims, and contain the most important gold-bearing veins so far discovered in this part of the map-area. The limestone interbeds of the basal part of the member are best exposed in the west fork of Cunningham Creek, in the upper part of Peter Gulch Creek, and on the Sterling and Shasta claims; elsewhere the geological boundary at the base of the member can be drawn only by inference.

The Hudson member has been outlined only between the headwaters of Simlock Creek and the inferred fault near the west fork of Cunningham Creek. Limestone beds that apparently represent the faulted continuation of the member are exposed in Cunningham Creek about one mile north of Trehouse Creek, on Nugget Mountain, in Nugget Gulch, and in the previously described section at Antler Creek, but the exposures are inadequate for detailed mapping. Similarly, limestone beds outcrop in the valley of Harveys Creek along the strike of the Hudson member, but the boundaries could not be outlined.

The members have a general strike of north 30 to 50 degrees west, the beds dipping northeast at various angles. The less-competent beds are sheared and drag-folded, prohibiting accurate estimates of the thickness of the members. Even the hard quartzite on Middle Mountain is flexed in open, minor folds.

The relationships found on and near the divide between Cunningham and Simlock Creeks, and a comparison with the succession occurring in Barkerville area, may be summarized by the following tabular sections:

BARKERVILLE GOLD BELT		KEITHLEY CREEK AREA		
Name	Exposed Width (Ft.)	Name	Exposed Width (Ft.)	Estimated Thickness (Ft.)
Barkerville formation, mainly limestone		Barkerville formation, mainly limestone		
Baker member, mainly fissile, grey, calcareous quartzite	1,500 to 2,000	Lostway member, argillite	1,000 to 2,500	300 to 800
Rainbow member, fissile, interbedded argillite and quartzite	900 to 1,500	Roundtop member, pure quartzite	1,500 to 2,800	500
B.C. member, argillite	Up to 800	Bee member, argillite	1,000 to 4,000	300 to 1,500
Lowhee member, mainly fissile, grey quartzite	Up to 2,000+	Hudson member: upper part, limestone, schist, argillite, quartzite; middle part, impure quartzite, schist; lower part, limestone, schist, argillite, quartzite	4,000	1,000
Basal member, argillite	100 to 1,000		4,000	1,000
Richfield formation, unsubdivided			2,500	600
		Richfield formation, unsubdivided		

The upper part of the Richfield formation, as now mapped in Keithley Creek area, shows a number of marked differences when compared with the Barkerville Gold Belt. The argillites of the Lostway member are quite distinct from the calcareous quartzites and schists of the Baker member. The pure white quartzite of the Roundtop member and the abundant limestone beds of the Hudson member have no counterparts in the upper Richfield in Barkerville area. The most important gold discoveries in the upper Richfield in Keithley Creek area have to date been made in the middle part of the Hudson member, whereas the Rainbow is the most favourable member of the Barkerville belt. Although the Hudson member contains impure quartzite bearing some resemblance to that of the Rainbow, the two members cannot be correlated because the Hudson is farther from the base of the Barkerville formation, and because of the limestone occurring above the middle of the Hudson member. The belt changes along its strike, the greatest change occurring between Grouse Creek and Antler Creek. Part of the discrepancy may be due to faults, such as the projection of the Lostway Creek fault, but the character of sedimentation must have changed along the strike if the Barkerville formation in Keithley Creek area represents the same stratigraphic horizons as the western belt of that formation in Barkerville area.

East of Cariboo River the upper part of the Richfield formation occurs in and near Little River Valley. Here bedrock is poorly exposed and it is impossible to divide the formation into members. The rocks are mainly impure quartzites and schists, but limestone beds and lenses are common. A thick limestone bed resembling the Barkerville limestone can be traced eastward from the falls at the forks of Little River to the east boundary of the map-area.

Barkerville Formation

The Barkerville formation, as mapped in Keithley Creek area, forms a belt 4,000 to 12,500 feet in surface width, extending southeast from Cunningham Mountain and crossing Cariboo River immediately below the mouth of Six Mile Creek. Beyond Cariboo River the belt swings eastward, in conformity with the general curving trend of the strata in that part of the area. The beds dip 40 to 80 degrees northeast, except where contorted by minor folds. The true thickness of the formation has not been determined because individual beds are repeated in places by minor folds, and probably also by strike faults. The belt is widest in the eastern part of the area, due probably in part to repetition of beds and to lower average dips, but as there is a southeastward increase in the amount of limestone in the Cariboo series it is probable that the true

thickness of the formation is greater in the eastern part of the area.

The formation consists essentially of limestone, which is of three main types. The commonest type is thickly bedded, massive, grey to cream, dolomitic in places, and includes both unmetamorphosed and crystalline phases. The other types are buff, crystalline limestone containing iron carbonate, and thin-bedded, blue to black, argillaceous limestone. Some beds are mottled, due to autoclastic structures. The formation includes many interbeds of quartzite, schist, and argillite similar to rocks of the Richfield and Pleasant Valley formations.

Pleasant Valley Formation

The Pleasant Valley formation consists of sheared argillites with many beds and lenses of limestone similar to the Barkerville limestone, and minor interbeds of quartzite, slate, phyllite, quartz-sericite schist, and chlorite schist. These beds form a belt up to about 15,000 feet wide, the strata apparently being repeated by minor folding that cannot be interpreted in detail because bedding planes in the argillites are commonly destroyed by shearing. The formation extends southeast from Cunningham Mountain and Tinsdale Creek at the northern boundary of the map-area. In the western part of the area it is mainly drift-covered, being best exposed in the canyon of lower Cunningham Creek.

East of Cariboo River the strata, correlated with the Pleasant Valley because of the stratigraphic position with respect to the Barkerville, contain abundant limestone beds interbedded with schist and quartzite, and here the Pleasant Valley does not correspond lithologically with the type locality in Barkerville area. As it is not always possible to distinguish the limestone of the Cariboo series from the Palaeozoic limestone on lithological grounds alone, it may be that some of the limestone mapped with the Pleasant Valley on and near the summit of Whitecap Mountain represents an erosional remnant of the nearby Palaeozoic strata.

Ishpa Formation

The southwest slope of Ishpa Mountain, in the northeast corner of the map-area, is underlain by schistose and fissile, impure quartzites with minor amounts of massive quartzite, argillaceous schist, and limestone. The beds have an average strike of north 50 to 60 degrees west and dip southwest at

various angles, being on the eastern limit of the synclinorium. The rocks resemble those of the Richfield formation, and were included in Bowman's "Cariboo schists".

Matthew Formation

Overlying the Ishpa is a succession of limestone beds with minor interbeds of argillaceous limestone, argillite, and quartzite, best exposed in the canyons of Matthew River and Comot Creek and on the north and east slopes of Kimball Mountain. The general strike of the beds is northwest and the prevailing dips are southwest, although minor flexures occur. The contact with the Ishpa formation is not exposed, but the general attitudes are conformable. The strata resemble, and are probably related to, parts of the Barkerville and Pleasant Valley formations, but are designated separately because the succession in the eastern part of Keithley Creek area does not correspond sufficiently with that of the Cariboo series in the western part of the area to permit definite correlations.

Kimball Formation

Conformably overlying the Matthew formation are beds of white to grey, fine-grained, massive to slightly fissile quartzite with interbeds of argillite, argillaceous quartzite, and green, schistose quartzite. These strata are exposed prominently on the summit of Kimball ridge and can be traced by scattered exposures northward to Matthew River. They form a belt up to a mile wide that ends near the east end of Kimball ridge where the strata are involved in a plunging syncline. The beds dip from about 40 degrees southwest to vertical, only the eastern limb of the syncline being exposed. These beds terminate abruptly against the Palaeozoic strata that form the southwest side of Kimball ridge, the contact being believed to be a strike fault that has dropped the southwestern limb of the syncline.

Cambrian Strata

A bed of hard, pale, massive quartzite overlain by green schist containing limestone interbeds, averaging half an inch in thickness, forms the lowest outcrops on the south slope of Kimball ridge, about $1\frac{1}{2}$ miles from the east boundary of the map-area. These beds appear to be the same as those underlying the eastern part of Anderson ridge, and are grouped tentatively with the Pleasant Valley formation. They are overlain with apparent conformity by about 600 feet of strata, consisting of thick beds of massive grey limestone separated by thin beds of limestone, black argillite, and dark grey, calcareous argillite. The

argillites at several horizons contain abundant trilobites, classed as Lower Cambrian by Dr. Chas. S. Resser. Above these beds are scattered outcrops of limestone and argillite containing Lower Cambrian fossils at a few localities; these are too poorly exposed to permit measuring a complete section or determining whether any beds are repeated by folding or faulting.

The Cambrian strata probably extend across Kimball Creek to the northeast slopes of Anderson ridge, which are mostly drift-covered. The few outcrops of argillite and quartzite there were searched carefully, but unsuccessfully, for fossils, and are mapped as Cambrian for structural reasons only.

Slide Mountain Series

In the synclinal trough strata consisting chiefly of limestone, argillite, and chert overlie the Cariboo series and Lower Cambrian beds unconformably. These younger strata are the southeastward continuation of the Slide Mountain series of Barkerville area, where the series is divided into four formations: the basal Guyet formation, consisting of conglomerate and gritty quartzite; the Greenberry, consisting of limestone carrying Carboniferous fossils; the Waverly, composed of lavas; and the Antler formation, consisting of argillite and chert. In the southeastern part of Barkerville area the Greenberry and Waverly are absent, the Antler formation resting upon the Guyet.

In Keithley Creek area fine-grained conglomerate and gritty quartzite occur at a few places in the low-lying, drift-covered region between Mount Tinsdale and Cariboo River. Elsewhere the lowest recognized beds of the Slide Mountain series consist of limestone and a little chert. The limestone forms a band about $1\frac{1}{2}$ miles wide extending from Turks Nose Mountain across Cariboo River Canyon and Jackpot Mountain to Kimball Creek. Similar limestone can be traced across Kimball Creek and along the north and south slopes of Anderson ridge, becoming narrower and finally pinching out near the head of the south branch of Kimball Creek. The rock consists of massive, white to grey, crystalline limestone in which bedding planes are generally lacking. It resembles much of the limestone of the Cariboo series, but fossils that have been classed as Permian or, possibly, Carboniferous were found at three localities. This limestone has been named the Jackpot formation. It may prove to be the equivalent of the Greenberry formation, but definite correlation cannot be made until the intervening territory has been mapped. An outcrop of limestone containing fossil fragments, on Mount Tinsdale, probably represents an isolated occurrence of the Jackpot formation. As the limestone narrows on Anderson ridge, calcareous cherts become

more plentiful, suggesting either gradually changing conditions of sedimentation or siliceous replacement of the limestone. Evidence of an angular unconformity between the limestone and underlying argillites and quartzites exists on the south side of Anderson ridge. The base of the Slide Mountain series was not found exposed on the west slope of Black Stuart Mountain; a prominent bed of limestone outcrops on the lower slope, but is considered part of the Cariboo series because the associated schists resemble rocks of that series. On Anderson ridge the formation is about 500 feet thick. The thickness in the wide band to the north has not been determined because the lack of bedding planes prevents an interpretation of the minor structures.

A succession of brown to black, shaly argillites with minor amounts of chert and fine-grained conglomerate overlies the Jackpot limestone. These beds are flexed by minor folds. The argillites are softer, fresher, and less sheared than those of the Cariboo series. They resemble the Antler formation, but have been mapped simply as Slide Mountain series because of the impossibility of separating them from the basal conglomerate and quartzite north of Cariboo River.

Limestone Conglomerate

A small body of conglomerate composed almost entirely of limestone occurs on a bench at the west side of Cariboo River between the canyon and Limestone Creek. The bed is about 75 feet thick and nearly flat-lying. It rests on beds of Slide Mountain argillite with an irregular contact, apparently due to erosion. The limestone boulders are up to 18 inches in diameter, one of the smaller boulders was found to contain a fossil similar to a species in the Jackpot formation. The conglomerate is, therefore, younger than the Jackpot, and as it appears better consolidated than a Tertiary deposit, its age is probably very late Palaeozoic or Mesozoic.

Intrusives

The Richfield formation is intruded by a few altered sills and dykes of acidic composition, resembling the Proserpine intrusives of Barkerville area. These rocks were originally quartz porphyry, felsite, and possibly, other related types, but are now much altered to carbonate and limonite, and contain some quartz that appears to be secondary. Being soft and weathering readily, these rocks do not form conspicuous outcrops, therefore they may be more abundant than their limited exposures would indicate. The best examples occur at the west side of Antler Creek half a mile north of Pittman Creek; others occur

near Yanks Peak and near the mouth of Pearce Creek. These intrusives are considered pre-Carboniferous in age because they have not been found intruding the Slide Mountain series and because Uglow found pebbles of similar igneous material in the basal conglomerate of that series.

The only large igneous exposure in the area is a stock of quartz monzonite near the head of the north fork of Little River. It extends beyond the eastern boundary of the area, the part within the area being about 1 by 2 miles in size. It intrudes limestone and other sediments correlated with the Pleasant Valley formation. More basic sills, dykes, and irregular intrusions that are in most cases too small to be mapped separately cut the Richfield formation, particularly near the southern border of the map-area, and intrude the Slide Mountain series on Green Cone and Black Stuart Mountains. The most common type is diorite, but quartz diorite, diabase, gabbro, and amphibolite also occur. The ages of the intrusives cutting the Cariboo Series cannot be determined definitely, but those of intermediate and basic composition are considered Mesozoic because of their resemblance to the intrusives near Green Cone Mountain and to the Mount Murray intrusives of Barkerville area.¹ The quartz monzonite stock is considered

¹ Johnston, W.A., and Uglow, W.L.: Placer and Vein Gold Deposits of Barkerville, Cariboo District, British Columbia; Geol. Surv., Canada, Mem. 149, p. 25 (1926).

Mesozoic because the rock is only slightly altered. A few small bodies of diabase much altered to carbonate and chlorite, occurring within a mile of Yanks Peak, may, because of their greater alteration, be older and represent more basic phases of the Proserpine intrusives.

STRUCTURAL GEOLOGY

The major structures consist of a broad anticlinorium in the western part of the area and a broad synclinorium in the eastern part. The main anticlinal axis extends southeastward from Mount Burdett to Mount Borland. The synclinorium consists of two principal folds, one on Kimball ridge and the other on Black Stuart-Anderson ridge.

The strata on the flanks of the major folds are contorted by small open folds and drag-folds, the less competent argillites and schists suffering greatest deformation.

Pre-mineral and post-mineral faults range from small slips to faults of great displacement. Some are actually traceable, others being inferred from the displacement of nearby strata. They are divisible into three main types: Strike faults parallel to the strike of the beds, but dipping more steeply than the beds; northeasterly trending faults; and northerly trending faults.

The contact of the Cambrian and Jackpot beds with the Kimball formation is well marked and is believed to be a strike fault.

A group of northeasterly trending faults in the northern part of the area cause large displacements of the Barkerville formation and adjacent strata. Those at Lostway Creek and on Cunningham Mountain can be traced, the remainder being inferred from the positions of scattered outcrops. In all but the Lostway Creek fault the south sides have been displaced westward. The Lostway Creek fault may extend through the valley of Wolfe Creek and displace the beds at the south end of Antler Mountain. The fault north of Roundtop Mountain probably extends near the west fork of Cunningham Creek, as the limestone beds of the Hudson member appear to be faulted between that creek and Nugget Mountain, but the exact position of the fault could not be determined. A further extension of this fault probably accounts for the displacement of the main anticlinal axis at the head of Little Snowshoe Creek.

A number of veins in the Richfield formation occupy faults striking north 10 degrees west to north 10 degrees east, the strata on the west sides in most cases being displaced southward.

The rocks of the Cariboo series are much fractured. The most common fractures are associated with the rock cleavage, being parallel to the strike of the bedding and either paralleling or crossing the dip of the bedding. Fractures of the latter type are parallel to the axial planes of drag-folds. Fractures crossing the strata roughly at right angles, in a northeasterly direction, are plentiful. A third, less common type crosses the strata diagonally in an easterly direction.

MINERAL DEPOSITS

Lode and placer gold deposits are the only mineral occurrences of commercial interest yet discovered in Keithley Creek area. Some of the lode deposits contain silver, lead, zinc, and tungsten, which might under favourable conditions be recovered as by-products of gold mining. The lode deposits are of two types: (1) quartz veins, and (2) sulphide replacements in limestone; veins being by far the most numerous and most important of the present discoveries within the map-area.

Distribution of Veins

Quartz veins occur abundantly in the Richfield formation, the highest gold assays so far being obtained from veins in the middle part of the Hudson member and in the vicinity of Yanks Peak. Prospecting and sampling of veins elsewhere in the Richfield have not been sufficiently exhaustive to indicate that the two localities mentioned are the only favourable parts of the formation. Veins occur in the other formations of the Cariboo series, but these have been little prospected.

The more auriferous deposits near Barkerville occur mainly in the Rainbow member of the Barkerville Gold Belt. The Rainbow and its adjacent members could not be traced south-east of Antler Mountain, the sediments changing in character along the strike. Therefore, although the general belt may be said to extend into Keithley Creek area at least as far as Harveys Creek, the Rainbow member is not considered to extend beyond Antler Mountain. Veins occur at the west side of Cunningham Creek, in the bed of that creek, near Penny Creek, and on the Cariboo Hudson claims. These discoveries form a zone in the middle part of the Hudson member, which is not lithologically identical with the Rainbow member and which occurs farther from the base of the Barkerville formation.. Many veins occur elsewhere in a wide belt in the upper part of the Richfield formation, prospecting not being advanced sufficiently to define either the length or the width of the more favourable zone.

Many veins occur near the axis of the anticlinorium, particularly in the vicinity of Yanks Peak, those that have received most attention being on the south slope of the mountain and within about 2 miles north and northeast of the peak. The veins are distributed over a wide area, in rocks of different types, and it is impossible at present to define a particular gold-bearing zone or zones.

Little prospecting has been done in the southern and eastern parts of the area. The Hudson member if projected would extend up the valley of Little River, where extensive overburden prevented detailed mapping. Numerous barren-looking veins occur near Barker Mountain. Veins containing some pyrite and rust occur in and near the stock at the eastern boundary of the area, and grab samples assay traces of gold.

Types of Veins

The quartz veins range from stringers a fraction of an inch in width to wide veins, some of which extend for several hundred feet. Although isolated veins are found, the usual occurrence is in zones of parallel or *en échelon* veins, stringers or lenses, and in groups in which the individual veins branch or cross one another in different directions forming complex vein-systems.

Despite the wide variations in the strikes of the veins, they may be divided into five types, according to their relationship to the strata. With due allowance for gradation between types, the groups are as follows:

- (1) Northerly trending veins, striking from north 10 degrees west to north 10 degrees east, that cross the strata diagonally. Most of these veins occupy faults and shear zones.
- (2) Transverse veins, striking north 30 to 70 degrees east, filling fractures that cross the strata approximately at right angles.
- (3) Veins striking north 70 degrees east to due east, filling fractures that cross the strata diagonally in an easterly direction.
- (4) Veins parallel or almost parallel to the strike of the strata, but dipping across the bedding, filling strike faults or fractures.
- (5) Veins conforming to the dip and the strike of the strata.

Gold occurs in some veins of all the above types, but the highest assays and the most massive sulphides have been found to date in northerly trending veins. Many of the veins paralleling the bedding appear to be barren, but some contain pyrite and have afforded low assays. Considering present

discoveries, and taking the area as a whole, the types are listed above in the order of their importance.

Mineralization

The vein quartz is of two types, the most common being white quartz that is generally well fractured, the other being vitreous. Both types are coarsely crystalline in places. Sulphides are most abundant in the less vitreous quartz, the most common sulphide being pyrite occurring in fine disseminations, crystals, and in massive aggregates distributed irregularly or in bands filling fractures parallel to the vein walls. In some veins the only sulphide is pyrite; in others this mineral is associated with sphalerite, galena, and arsenopyrite. A few veins contain small amounts of pyrrhotite, chalcopyrite, and tetrahedrite. Massive sulphides occur principally in the northerly trending veins. Scheelite occurs in small aggregates in certain northerly trending veins. In addition to quartz, some veins of different types contain iron carbonates, calcite, sericite, and graphite as gangue minerals.

Most of the free gold is finely divided in pyrite and sphalerite. A particularly high-grade type of fine-grained, dark pyrite is found microscopically to contain much sphalerite. Samples of seemingly pure, gold-bearing galena and arsenopyrite are found to be mixtures of minerals. In some veins the distribution of gold and sulphides is fairly uniform and in others they occur as high-grade shoots.

The walls and rock inclusions of many veins and zones are unevenly impregnated with pyrite, usually in cubes. No information is available regarding the gold content of such pyritized rock. Less common forms of wall-rock alteration are silicification and sericitization, which are never intense.

Replacement Deposits

A few limestone beds in the belt between Antler Mountain and Harveys Creek contain disseminated pyrite or massive aggregates of pyrite, pyrrhotite, sphalerite, and galena. Gold assays have been reported from some of these deposits, but none has yet been shown to be of commercial size and grade.

Age and Origin of Mineral Deposits

The mineral deposits were formed by solutions believed to have originated from igneous intrusions underlying parts of the area at depth. The presence of scheelite, arsenopyrite, pyrrhotite, and glassy quartz suggests that at least part of the deposits were formed at fairly high temperatures.

Some of the bed veins appear to have been folded with the strata. The veins crossing the strata are younger than the typical bedded veins, and in some deposits branch from one type to another, suggesting that the different types crossing the strata are nearly contemporaneous.

The vein-filled fractures and faults appear to be most abundant near the anticlinal axis and in the upper part of the Richfield formation. The thick limestone beds in the upper part of the Hudson member may have acted as competent units against which the less competent rocks were sheared and fractured, and may also have had some effect in impounding the mineralizing solutions. Most of the veins occur in impure, schistose, and fissile quartzites, which reacted most favourably to fracturing and shearing. Where veins extend from these rocks into hard, massive quartzites they tend to narrow abruptly, and where they extend into soft, friable schists and argillites they tend to split into numerous stringers.

Uglow¹ found placer gold and vein quartz containing

¹Op. cit., pp. 20, 191

pyrite in the basal conglomerate of the Slide Mountain series, and concluded that the veins in the Cariboo series are pre-Mississippian in age and probably related to the same parent intrusives as the Proserpine intrusives. The occurrence in the southeastern part of the area of veins containing pyrite and traces of gold near intrusives probably of Mesozoic age, suggests that some of the deposits are of Mesozoic age.

Prospecting

Most of the territory near Yanks Peak and between Antler Mountain and Harveys Creek is staked. The most likely field for prospecting on unstaked ground is the remainder of the Richfield formation. The southern and southeastern parts of the area contain veins, particularly near the intrusives. The formations other than the Richfield, although not as favourable, have been

so little prospected that their possibilities remain unproved. The discovery of intrusives cutting the Slide Mountain series indicates that even it may repay prospecting. The rocks resembling the Richfield, in the northeastern corner of the area and beyond, will no doubt be prospected in time, but that district is rather inaccessible. It is worth noting that placer discoveries were made on Comet Creek in the eastern part of the area in 1915, and on Kimball Creek in the Slide Mountain series in 1917.

Ore shoots may be developed in the more fractured parts of large veins that, as a whole, are uncommercial. Where the veins are small or lenticular the best possibility is the proving of closely spaced vein systems that may, in the aggregate, form a deposit of commercial grade and tonnage. Although some free gold occurs, the association of gold with sulphides is so well established that these minerals form the best indications for prospecting, any deposits containing sulphides or rust being worth sampling.

Description of Properties

Antler Mountain (1)¹

E. Armstrong and associates hold a group of claims extending along the summit of Antler Mountain, only the southern

¹This number appears on an accompanying map where it indicates the approximate position of the property.

claims being within Keithley Creek area. The rocks, which are not well exposed, consist of massive and fissile quartzites, argillaceous quartzite, and schist. These are on the projected strike of the Rainbow and its adjoining members. The fact that the claims lie above the old and extensive placer workings on Beggs and Stevens Gulches supports the belief that they are on the projection of the Barkerville Gold Belt.

Much shallow trenching was done in 1933 when the group was optioned to the Premier Gold Mining Company, Limited. This work exposed many veins and lenses, distributed individually and in groups, and striking in three general directions. One type consists of veins and lenses up to about 4 feet wide, striking north 30 to 40 degrees west and dipping at an average of about 50 degrees northeast. Stringers and veins up to 8 inches wide strike north 55 to 75 degrees east, crossing the strata at right angles or slightly diagonally. Veins up to 15 inches wide strike north 15 degrees west to north 5 degrees east.

The vein matter consists of white quartz that is somewhat rusty, containing pyrite and sericite in places. In the work done in 1933 the highest assays were obtained from a vein on the Grouse claim, near the north end of Antler Mountain. Mr. Armstrong states that in recent work on this claim a vein paralleling the bedding was found to widen to 7 feet at a depth of 10 feet, about half the vein being strongly mineralized with galena, pyrite, arsenopyrite, and sphalerite. Good assays were obtained from selected samples.

Bridger and Johnston Claims (2)

These claims cover the mouth of Nugget Gulch, and are underlain by interbedded schist, quartzite, and limestone of the Richfield formation, most of the beds striking about north 60 degrees west.

About 500 feet northeast of the Nugget Gulch road an adit has been driven 15 feet in massive, grey quartzite, following a vertical vein averaging 8 inches wide and striking north 40 degrees east. The quartz is rusty, but no sulphides were seen.

Gold assays are stated to have been obtained from a replacement deposit in limestone, now buried by tailings, at the mouth of Nugget Gulch, and from a northerly striking vein 6 inches wide at the west side of Antler Creek opposite Nugget Gulch.

Nugget Mountain (3)

On the southeast slope of Nugget Mountain about 100 feet above Cunningham Creek W.E. Thompson and associates drove an adit 137 feet long in fissile, black argillites that are probably the continuation of the Bec member. The adit follows a vein 2 to 5 feet wide that parallels the bedding and strikes north 50 degrees west. It was lost about 60 feet from the portal, crosscutting for 25 feet to the north failing to locate it. The quartz contains sparse disseminations of pyrite, galena, and sphalerite, only low gold assays being obtained.

Canadian Group (28)

The Canadian group, owned by W.E. Thompson and others, includes seven claims on the steep hillside west of Cunningham Creek immediately below the mouth of Peter Gulch Creek. The rocks of the southern claims are interbedded schist, quartzite, and limestone classed as the middle part of the Hudson member. The strata at the northern claims are chiefly argillite.

In 1937 a number of cuts were ground-sluiced on the Canada No. 2 and No. 4 claims at the west side of the creek, when the group was optioned to Carl Springer. Seven veins were exposed, some striking north 70 degrees east and others not being sufficiently exposed for a determination of the strike. The quartz contains fresh and oxidized pyrite in places. C.R. Rumsey, who was in charge of the work, stated that gold assays up to 0.76 ounce had been obtained.

Wendle Group (6,7)

This group, owned by J. Wendle and associates, consists of about one hundred claims, extending from Trehouse Creek to the mouth of Simlock Creek. The group adjoins the Canadian group to the southeast, and almost surrounds the Cariboo Hudson claims. Work was done originally on the "E" or "Bralco" part of the holdings, on the divide between Penny and Simlock Creeks. Since 1935 work has been concentrated on the northern claims, when the group was optioned to the Coniagas Mines, Limited, and the Newmont Mining Corporation. This later work was chiefly at two localities: the "north showing", 750 feet north of Penny Creek and immediately east of the tractor road; and the "Copper Creek showing", near the mouth of Penny Creek.

Most of the claims are underlain by the Hudson member of the Richfield formation, the North and Copper Creek showings being in the middle part of that member and the Bralco showings in the upper part.

North Showing. On the Native No. 3 claim a zone of parallel, lenticular quartz veins fills northerly striking fault fissures in schistose to massive quartzites that strike north 40 to 50 degrees west. The limits of this zone are unknown, it being stripped at intervals for a width of about 150 feet and a length of roughly 200 feet. At the surface the veins average about 6 inches in width and are poorly mineralized.

The most westerly vein has been exposed for a length of about 140 feet, chiefly by an adit driven 121 feet along the strike, a few feet below the surface. Here the width of the vein varies up to 3.8 feet. Branching stringers up to 8 inches wide occur, some swinging parallel to the bedding of the wall-rock; in the last 20 feet of the adit the vein branches into stringers or "horse-tails".

In the opencut and adit the vein is well mineralized with pyrite and some arsenopyrite, galena, sphalerite, scheelite, and iron carbonate. The sulphides occur principally in a massive band up to 30 inches wide that forms the west side of the vein. The greater vein and sulphide widths occur where the wall-rock is most sheared, the widths narrowing in the more massive quartzite. C.R. Rumsey informed the writer that the arithmetical average of sampling in 108 feet of the vein was 1.2 ounces of gold a ton for an average width of 20 inches.

About 4 tons of cobbled material from the vein was shipped to the Trail smelter, the following information being quoted from the smelter return furnished by Mr. Wendle:

Dry weight of sample	7,975 pounds
Gold	7.6315 ounces a ton
Silver.....	2.6 ounces a ton
Lead	1.9 per cent
Zinc	0.6 per cent

A winze was sunk 26 feet on the vein, which is inclined 75 degrees to the west. This contained water when the property was visited, the vein being said to narrow 8 or 10 inches at the bottom, the sulphide band narrowing to a thin streak.

Copper Creek Showing. At the north side of Penny (Copper) Creek, 120 feet east of the trail, a vein striking north 5 degrees east and dipping 80 degrees east lies in a fault fissure trending diagonally across contorted beds of argillaceous quartzite striking north 45 degrees west. The vein varies in width up to about 10 feet and has been stripped for a length of about 80 feet north of the creek. Cuts expose it to a depth of about 5 feet. At the north end the vein pinches, forming a number of stringers striking with the foliation of the sheared quartzite. Near the south end of the exposure a branch from the main vein strikes south 30 degrees west. A fault striking about north 30 degrees west, near the creek, terminates the branch vein, but the main vein extends southward across the fault for a few feet and then appears to split into a number of stringers. An adit at the south side of the creek follows the main fracture for 12 feet, exposing scattered quartz and pyrite. The quartz of the main vein contains nests of pyrite and scheelite, and a little calcite. The vein is exposed to a maximum depth of 5 feet, pyrite becoming more evenly distributed. Surface samples are stated to have averaged about \$4 a ton in gold, the gold content increasing with the pyrite at the bottom of the cuts. A vein containing pyrite and galena, at the west bank of Peter Gulch Creek, may mark the southern extension of the zone.

A vein 1 foot wide, striking north 30 degrees west and dipping 65 degrees northeast parallel to the bedding, is exposed in the banks of Penny Creek roughly 3,000 feet east of the trail. This vein contains a little disseminated tetrahedrite. About 500 feet downstream a quartzose zone in schistose rocks strikes north 50 degrees west and dips 54 degrees northeast. The zone contains irregular masses of quartz sparsely mineralized with pyrite and galena. It is crossed by a vein 8 inches wide, striking north 10 degrees east and dipping 83 degrees southeast, containing a little galena. The walls of the zone contain thirteen apparently barren, transverse stringers up to 2 inches wide. Only low gold assays have been obtained from these and other veins exposed in the upper part of Penny Creek.

Bralco Group. A number of veins are exposed in shallow opencuts on the Bralco claims. These workings are scattered, so that the relationships between the various occurrences are not yet apparent. It is understood that only low gold assays have been obtained. Many of the veins are exposed in a single opencut, so that lengths can in few cases be stated.

On the Sedan fraction, near the east boundary of the Hudson claim, a vertical quartz vein 30 inches wide strikes north 70 degrees west, its relation to the schist wall-rock not being apparent. The quartz is fractured across the strike of the vein, which contains rust, but no visible sulphides.

About 450 feet north of the southwest corner of the Sedan No. 3 claim an irregular quartzose zone 2 feet wide, in buff quartz-sericite schist, strikes north 40 degrees west, dips 50 degrees northeast, and is sparsely mineralized with pyrite.

A bedded quartz lens in argillite, 660 feet east of the northwest corner of the Peerless No. 2 claim, is up to 2 feet wide, is strongly cross-fractured, and contains a stringer of galena 2 inches wide. About 650 feet east of the southwest corner of the Horseshoe No. 2 claim a bedded quartz zone in limestone, striking north 40 degrees west and dipping 63 degrees northeast, contains a little disseminated galena and chalcopyrite. The width of the zone is not exposed.

Several veins are exposed in scattered opencuts near the boundary between the Surprise No. 2 and No. 4 claims. A bedded zone 9 feet wide consists of barren quartz and inclusions of schist. A vein 2 feet wide lies along a contact between beds of limestone and schist, striking north 50 degrees west and dipping 65 degrees northeast, the limestone being partly silicified.

A vein striking due north and dipping 65 degrees east cuts diagonally across a bed of limestone. A compound vein about 6 feet wide, consisting of two parallel veins 2.5 and 1 foot wide, at a contact between schist and limestone, strikes parallel to the foliation of the schist, but dips across it. No sulphides were seen in the veins mentioned in this paragraph.

A replacement zone 19 feet wide, striking north 40 degrees west and dipping 72 degrees northeast, occurs in limestone near the northeast corner of the Surprise No. 2 claim. It has been traced at intervals for about 250 feet. The zone is well mineralized with sphalerite and contains some pyrite and galena.

Near the southwest corner of the Surprise No. 2 claim a vein 8 inches wide, striking north 60 degrees west and dipping 72 degrees southwest, contains much rust. This vein strikes parallel to the foliation of its schist walls, but crosses the dip of the foliation.

On the Odd No. 10 claim, 350 feet from the northwest corner of the Sedan No. 3 claim, a vein occurs in fissile quartzite striking north 40 degrees west and dipping 70 degrees northeast. The vein, which is 14 inches wide, strikes with the quartzite. About 100 feet to the west, a vein up to 2 feet wide, striking north 45 to 55 degrees west and dipping 75 degrees northeast, parallel to the shearing of the quartzite in which it occurs, contains rust in fracture planes, but no sulphides.

Cariboo Hudson Gold Mines, Limited (8,9,10)

This company owns the Hudson, Cutler, Black Martin, and Cunningham groups of adjoining claims, which extend southeastward from Penny Creek for 2 miles. These claims are underlain principally by the middle part of the Hudson member of the Richfield formation, consisting of rusty weathering, schistose, and fissile quartzites and schist. The more westerly claims are underlain by the lower part of the Hudson member, where limestone is interbedded with quartzite and schist. The upper part of the member occurs to the east, on the adjoining Bralco claims, and contains much interbedded limestone. The strata strike north 30 to 75 degrees west and dip 50 degrees northeast to vertical.

The Hudson group of six claims is being developed at present, the work being chiefly on the Hudson claim (No. 9816), which covers part of the narrow divide between Pearce and Simlock Creeks. The Hudson claim is adjoined to the northwest by the First of July claim, to the southeast by the Glen Echo claim, and

to the southwest by the Shasta claim. The Glen Echo is adjoined to the southwest by the Shasta No. 2 claim and to the southeast by the Fourth of July claim. The Glen Echo and Fourth of July claims are on a very steep sidehill at the head of Simlock Creek.

These claims contain few outcrops, but a vein-system is partly exposed by a number of trenches on the Hudson, Glen Echo, and Shasta claims. This vein-system is not sufficiently exposed to permit a full interpretation of its details. The exposures occur at intervals for about 1,500 feet, from the centre of the Hudson claim to the centre of the Glen Echo. The line of exposures trends south 55 degrees east, corresponding to the general strike of the strata, but most of the individual veins strike northerly, northeasterly, and easterly, occurring in faults and fractures that cross the strata. The veins are up to 6 feet wide at the surface, and composite exposures are up to 17 feet wide. Some of the surface exposures contain pyrite, galena, and scheelite, and in others no sulphides are visible. The northern part of the vein-system is now being explored by underground work.

In 1923 an adit, which is now caved, was driven in the south bank of Pearce Creek, near the centre of the Hudson claim, at a point where four bodies of quartz up to 2 feet wide are imperfectly exposed in the creek bed. Quartz on the dump is well mineralized with pyrite and galena, samples of galena being reported to have assayed: Au, 2.24 ounces a ton; Ag, 5.5 ounces a ton; Pb, 32 per cent.¹

¹ Ann. Rept., Minister of Mines, B.C., 1925, Pt. C, p. 15.

About 150 feet south of the caved adit and 70 feet above it an adit was driven south 7 degrees east for 51 feet. It follows the hanging-wall of a steeply dipping vein containing galena, pyrite, iron carbonate, scheelite, and sericite. Twenty feet from the portal 2 feet of quartz well mineralized with pyrite and galena is exposed, the vein at this point striking due north and dipping 70 degrees west and the schist walls being sheared parallel to the vein. At 27 feet from the portal a crosscut exposes 4 feet of well-mineralized quartz, the vein being unexposed beyond this point. At the face of the adit an 18-inch zone of narrow stringers strikes north 60 degrees west, some of the stringers being parallel to the foliation of the schist and others crossing the foliation irregularly. The following assays have been reported from this adit:

Across 4 feet at 27 foot from the portal: Au, 2.98 ounces a ton; Ag, 5.50 ounces a ton; Pb, 24 per cent.

Across 3 feet at the face: Au, 0.54 ounce a ton; Ag, 1.26 ounces a ton; Pb, 7.6 per cent.¹

¹Ann. Rept., Minister of Mines, B.C., 1929, p. 191.

On the surface, at the foot of the dump, 6 feet of mineralized quartz is exposed on the strike of the vein in the adit; and above the adit the vein is exposed for a width of 7 feet, and also a second vein 5 feet wide, striking north 55 degrees west.

Underground work was begun in 1937 to explore the Hudson showings at somewhat greater depth, an adit being driven from the bank of Pearce Creek on a bearing south 85 degrees east. This entry is at an approximate elevation of 5,600 feet, and is 70 feet below the upper adit and about 150 feet below the summit. A large, well-mineralized vein, called for convenience the "main intersection" was crosscut 280 feet from the portal, about 50 feet vertically below the quartz outcrops at the foot of the upper dump. At 230 feet from the portal a drift was run to the north-east, intersecting a maximum of 6 feet of quartz at a distance of 90 feet from the main crosscut. At 329 feet from the portal a long drive was begun at a bearing of south 6 degrees west. This drive intersected a quartz lens containing pyrrhotite, at 59 feet from the turn, and at this distance a winze inclined 73 degrees north was sunk to a reported vertical depth of 98 feet. The winze was not examined, as it was filled with water. At 100 feet from the turn a short crosscut was driven west, encountering the main vein at a distance of 25 feet; this being termed the "south intersection". When the property was visited on October 20, 1937, the drive had been extended 570 feet from the turn, and had intersected two unmineralized, eastward-dipping faults striking north 15 degrees west and north 30 degrees west. It was the intention of the management to extend this working a further distance of about 280 feet to explore beneath the main showings on the Shasta claim, and recent reports in the press indicate that this objective has been reached.

The workings on the main level penetrate schistose quartzite and quartz-sericite schist, and a little argillaceous schist. These rocks strike north 45 to 75 degrees west and dip 55 to 80 degrees northeast.

At the main intersection the vein is 6 to $9\frac{1}{2}$ feet wide, striking due north and standing vertically. It consists of white, fractured quartz containing bands and irregular masses of sulphides, iron carbonate, and some scheelite. Pyrite, sphalerite, and galena constitute about 15 per cent of the vein. The east side of the vein consists of a sulphide band 5 to 12 inches wide in which fine-grained pyrite predominates. No visible gold was found by the writer, but a little is reported to have been found at this intersection. At the south intersection the vein is $7\frac{1}{2}$ to 9 feet wide, strikes north 10 degrees west, and is vertical. It resembles the main intersection. The two intersections are evidently on the same vein, 100 feet apart, and are believed to be the same vein as that exposed in the upper adit, the deeper exposures being somewhat wider and containing a greater proportion of pyrite and sphalerite. The vein encountered in the north drift contains large nests of pyrite. It is on the projection of the main vein, but strikes about north 50 degrees west; only further exploration can determine whether this is a separate vein or a deflected part of the main vein. The management stated that the sampling at the main intersection averages about \$50 a ton in gold, and at the south intersection about \$35 a ton. Selected samples of pyrite and sphalerite are stated to indicate about an equal gold content, galena containing less gold.

Shasta Claim. The main showings on the Shasta claim, in the southeast corner near the Hudson boundary, consist of a zone of lenticular veins exposed at intervals in a northerly direction for about 180 feet. The largest body, near the centre of the zone, is 8 feet wide and about 30 feet long. It strikes north 10 degrees east and dips 45 degrees southeast, crossing schist striking north 30 degrees west, and consists partly of massive quartz up to 4 feet wide and partly of silicified schist up to 4 feet wide, the schist containing quartz stringers and nests of galena. Massive quartz on the dump of the open-cut is well mineralized with galena.

Cunningham and Cutler Groups. The principal discoveries on the Cunningham and Cutler groups, formerly known as the Homestake, are on the banks of Peter Gulch Creek near the mouth of Pearce Creek, at elevations of 4,900 to 5,000 feet. Rock exposures are practically confined to the creek and consist of grey and buff sericite schists, which are talcose in places, impure quartzite, and limestone. The beds strike north 30 to 45 degrees west and dip steeply northeast.

Near the mouth of Pearce Creek a replacement deposit in limestone strikes north 43 degrees west, being exposed for a length of 72 feet. Widths up to 4 feet are well mineralized with

galena, pyrrhotite, pyrite, and sphalerite. The following assays have been reported:

Sample across 4 feet: Au, trace; Ag, 9.0 ounces a ton; Pb, 32 per cent; Zn, 1 per cent. Sample across 2 feet: Au, trace; Ag, 5.5 ounces a ton; Pb, 24 per cent; Zn, 8 per cent.¹

¹Ann. Rept., Minister of Mines, B.C., 1925, pt. C, p. 15

In 1933 an adit was driven 50 feet in the west bank of Peter Gulch Creek, about 500 feet above the mouth of Pearce Creek. The adit follows a bed vein up to 16 inches wide flanked by parallel stringers in schist. The zone strikes north 38 degrees west and dips 80 degrees northeast. The quartz contains pyrite and a little galena. A crosscut was driven for 60 feet to the south, exposing a few narrow bed veins. A sample from this zone, taken across 5 feet before the adit was driven, is reported to have assayed: Au, 0.28 ounce a ton; Ag, 0.1 ounce a ton.²

²Idem, 1925, pt. C, p. 15

Sterling Group (11)

The Sterling claims, at the head of Peter Gulch Creek, lie southwest of the Cariboo Hudson group. The property was idle when visited in 1935 and 1936. Bedrock is poorly exposed, consisting of interbedded schistose quartzite, quartz-sericite schist, and limestone, with a little argillite, which is graphitic in places. Some of these strata form the lower part of the Hudson member.

Shallow surface prospecting has been done, particularly on the Overland No. 1, Federal No. 2, and Federal No. 3 claims, where several bed veins, transverse stringers, and northerly trending veins outcrop or are exposed in pits. Some of these are sparsely mineralized with pyrite.

The largest exposure seen is a zone of quartz veins exposed for a width of 96 feet in the bed of Peter Gulch Creek, about 1,000 feet north of the camp. The rocks at this locality consist of schistose, impure quartzite with interbedded graphitic schist, and contain several imperfectly exposed bed veins up to 1 foot wide. This zone is crossed by two veins up to 2 feet wide, striking north 10 degrees west and dipping 70 degrees east, the quartz containing a small amount of disseminated pyrite.

On the Federal No. 2 claim, at the eastern border of the property, two pits 70 feet apart, on a line striking north 40 degrees west, contain a soft, rusty mixture of carbonate and shattered quartz for a width of 4.5 feet. The zone is crossed by three transverse quartz stringers up to 2 inches wide. A low gold assay is stated to have been obtained from material taken from these pits.

Claims Near the West Fork of Cunningham Creek (4,5)

The Cariboo Nordine group, consisting of twelve claims held by R.M. Abernothy and associates, is about 3 miles up Cunningham Creek from its junction with Peter Gulch Creek. Bedrock consists chiefly of impure quartzite and schist, striking northwest and dipping steeply northeast. A number of bed veins and veins crossing the strata at various angles outcrop on the claims, and are mineralized with pyrite and galena in places. Little work has yet been done. The owners were not at the property when the writer was in the district, but they informed him that low gold assays had been obtained from a group of four veins up to 12 feet wide situated at the south side of the creek.

A group of claims adjoining the Cariboo Nordine claims to the northwest, on the southern slope of the ridge separating Victorian and Cunningham Creeks, are held by F.M. Wells. Quartz veins outcrop on the claims, but little prospecting has yet been done.

S. Allison and associates hold a group of claims west of the Wells group, where veins occur in quartzites and schist. Mr. Allison states that gold assays have been obtained from surface samples.

Hobson Group (12)

The Hobson group, owned by B.E. Taylor, consists of eight claims, at elevations of 5,700 to 6,100 feet on the south side of Aster Mountain. The claims are reached by trail from Little Snowshoe Creek, or by way of Snowshoe Plateau.

The exposed rocks are schistose quartzite and graphite schist, occurring about a mile southwest of the anticlinal axis in the Richfield formation. Work has been concentrated on a large quartz vein up to 14 feet wide, traced at intervals for about 1,500 feet in a direction averaging north 40 degrees west. The vein is approximately parallel to the foliation of the wall-rock. The quartz contains sparse disseminations of pyrite,

galena, and sphalerite. Visible gold is said to have been found in places, but was not seen by the writer. Mr. Taylor states that samples taken by him across the full width of the vein assayed from a trace to \$11.70 a ton at the old price of gold.

At an elevation of 5,900 feet on the steep sidehill an adit has been driven for about 90 feet along the west wall of a vein, 6 to 8 feet wide, striking north 10 degrees west and dipping 80 degrees west, which appears to be the continuation of the vein described above, despite the difference in strike. Since the writer's visit Mr. Taylor states that he began another adit near the point where he obtained the highest assay, intending to crosscut the vein at a depth of 75 feet.

Several small transverse veins occur on the property, one of these having afforded an assay of 0.308 ounce a ton in gold.

Holmes Ledge

Bowman gives the following description of a vein on the northwest side of Aster Mountain:

"The Holmes Ledge, Breakneck ridge, head of Six-mile creek, on the Antler trail, strikes east and west; attitude nearly vertical. It is a comb of slate extending down from the mountain, the country rock striking northwest, dip northeast 70 degrees. Cleavage lines of large masses appear to correspond with the strike of the rock. Body of ore very considerable, in the shape of nests from 3 to 6 feet in width, the continuity of which has not been determined by openings. Contents: galena, and iron pyrites, with zinc blende, accompanied by white oxides; galena in considerable abundance. A sack of the ore was sent to San Francisco for a working test, which resulted very favourably, having yielded, it is said, a profit to the owner, above cost of test."

Gorrie Claims (13,14,15,16)

P. Gorrie and associates hold a large group of claims on Snowshoe Plateau. Numerous quartz veins of different types outcrop, many of them projecting through the shallow overburden.

The claims are underlain by the Richfield formation, the rocks consisting of interbedded impure quartzite, quartz-sericite schist, and argillite, with minor quantities of ferruginous quartzite, limestone, and graphitic schist. The main anticlinal axis extends through the claims, and strikes north 30 to 40 degrees west.

A large vein outcrops prominently on the Imperial claims immediately east of Aster summit, 2 miles north of Yanks Peak. The largest outcrop is about 100 feet long and 40 feet wide, beyond which the vein can be traced northward by intermittent exposures for about 1,000 feet. The vein strikes due north and appears to be nearly vertical, the wall-rock being exposed only in two pits, where it is black, argillaceous schist whose strike is not evident, but, judging by nearby outcrops, the vein crosses the strata diagonally. The quartz has a bleached, barren appearance and samples are reported to have indicated only a slight gold content. The vein is of interest because it may lie along the continuation of the zone containing the Midas and Jane veins.

The Cornish ledges, about 4,000 feet due east of the Imperial vein, form a zone of ten parallel veins from 1 to 2 feet wide, occurring over a total width of about 150 feet and exposed for a maximum length of about 250 feet. The veins strike north 55 to 65 degrees west and dip 85 degrees northeast. They occur in sheared quartzite and schist foliated parallel to the veins. The quartz contains a little disseminated pyrite and galena, and it is said that a party of early Cornish miners mortared gold from the quartz.

A zone containing at least seven veins, individually up to 6 feet wide, is exposed on the Crystal Extension No. 1 claim, about 3,000 feet south of the Cornish ledges. Some strike north 70 degrees west and others strike northeast at a variety of angles, forming a branching stockwork about 200 feet wide and 300 feet long in sheared quartzite and schist. The quartz contains disseminated pyrite and galena. Scattered vein outcrops occur along the general strike of the zone to the southwest. To the northeast, four veins striking about due north outcrop for short distances on the Crystal No. 4 claims; these contain a little pyrite and galena and occur in argillite and graphitic schist. A vein on the Crystal claim, up to 5 feet wide and striking north 75 degrees east, exposed in a single pit, is stated to have yielded assays of 0.27 to 0.054 ounce of gold a ton. On the Crystal No. 3 claims assays of 0.48 ounce of gold and 10 ounces of silver a ton are stated to have been obtained from picked samples well mineralized with pyrite and galena, taken from a vein 2 feet wide and striking north 45 degrees west. The relation of this vein to its enclosing rocks is not apparent, but nearby outcrops strike north 12 degrees west, therefore the vein probably crosses the strata.

Plateau d'Or Group. Work in 1936 was concentrated on the Plateau d'Or group of three claims, at elevations of 5,500 to 5,800 feet, near the head of French Snowshoe Creek.

Several parallel veins striking north 30 to 40 degrees west outcrop, as well as a few smaller transverse and diagonal veins, the length of the general zone being about 400 feet. The two principal veins, known as the East and West veins, occur at the southeastern end of the zone, where most work has been done. The following description of the zone commences with the lowest and most southeasterly open-cut.

The lowest cut exposes an intersection of two veins. A galena-bearing vein 18 inches wide, which is apparently the East vein, strikes north 30 degrees west across the strike of the argillite wall-rock, which here has an abnormal strike of north 70 degrees east. The other vein, which is 3 feet wide and parallels the foliation of argillite, contains a little pyrite and galena. The East vein appears to cross the bed vein, which is cross-fractured.

The East vein is exposed at both sides of a narrow draw about 90 feet northwest of the lowest cut. At the south side of the draw the East vein is 6 feet wide, no sulphides being exposed. At the northern side of the draw the vein is 5.5 feet wide, striking north 30 degrees west and dipping 65 degrees northeast. The quartz, which contains some galena, pinches out 8 feet below the surface of the outcrop. The East vein outcrops practically continuously for about 100 feet northwest of the draw.

The West vein is exposed at the south side of the draw, about 30 feet southwest of the East vein. It is about 8 feet wide and strikes north 40 degrees west, parallel to the foliation of the schist. A transverse vein 1 foot wide strikes north 60 degrees east. At the intersection, the West vein is strongly cross-fractured in a direction parallel to the transverse vein. Near the intersection, the West vein contains much limonite, some pyrite, and considerable galena, and the quartz is honey-combed with pits from which pyrite has been leached.

The West vein is exposed in a pit about 100 feet to the northwest, 25 feet from the outcrops of the East vein. The rusty schists forming the walls are crumpled, but the vein follows the general strike of the foliation. Here the dip of the vein is reversed, to 45 degrees west, probably due to local distortion near the surface.

About 50 feet east of the northwestern end of the outcrop of the East vein a parallel vein outcrops intermittently for about 150 feet.

About 150 feet east of the northwestern end of the outcrop of the East vein a diagonal vein strikes in an easterly direction. This vein is irregular and the walls are poorly exposed. It has a maximum width of 5 feet, stringers up to 6 inches wide branching from it and following the foliation of the schists. The quartz contains abundant sericite, but no sulphides were seen.

The highest assays have been obtained from the West vein, where Mr. Chettleburgh states that a channel sample across 8 feet 2 inches assayed 0.04 ounce of gold, 9.1 ounces of silver, and 10.1 per cent lead a ton; a second channel across 8 feet 7 inches assayed 0.28 ounce of gold, 6.4 ounces of silver, and 7.6 per cent lead a ton. He also states that thirteen samples taken from various parts of the property averaged 0.09 ounce of gold a ton, and that twelve samples averaged 4.5 ounces of silver a ton.

Jane Group (18)

The Jane group covers the summit and south slope of the ridge separating Luce and Little Snowshoe Creeks, one mile north of Yanks Peak. It is an old property known originally as the Haywood. In recent years the claims have been held by R. Reinholt, of Keithley Creek, who has done additional development work. The Wells mining Corporation acquired the group in 1937.

The claims are underlain by sediments of the Richfield formation lying immediately west of the anticlinal axis. The strata dip southwest at different angles, and their strikes vary considerably but average about north 25 degrees west. The mineralized zone occurs in brown and greenish schists and schistose argillites. To the northeast, the beds are chiefly schist and argillaceous quartzite with minor interbeds of argillite, limestone, and sheared conglomerate. A small body of much-altered diorite outcrops about 2,000 feet northeast of the workings.

A variety of veins are exposed by short adits and open-cuts on the south side of the ridge. The largest veins strike due north to north 16 degrees east. A few smaller veins strike north 30 degrees east, due east, and north 60 degrees west, their intersections with the larger veins being unexposed. The quartz contains disseminated pyrite and galena in places, and specimens containing free gold were shown to the writer.

The upper or No. 1 adit is at an elevation of approximately 5,400 feet. When visited it had been driven about 35 feet, following a vein 3 to 5 feet wide, striking due north to north 10 degrees east and dipping 65 degrees east. The schist

walls, which are impregnated with pyrite in places, are too deformed for a determination of their attitude. At the face, the quartz has been crushed by a flat fault which apparently displaces the upper part of the vein about 3 feet to the east. About 4 feet from the face, at the west side of the adit, a vertical vein 8 to 12 inches wide strikes north 60 degrees west, its intersection with the main vein being unexposed. A specimen stated to be from this vein was well mineralized with free gold. A vein at the west side of the adit near the portal, 6 to 12 inches wide and striking due east, contains pyrite. A sample from the main vein, across 5 feet, is reported to have assayed 0.44 ounce of gold and 0.2 ounce of silver a ton.¹

¹Ann. Rept., Minister of Mines, B.C., 1929, p. 194

Mr. Reinholt states that three samples taken in sections about 6 feet long on the west wall of the adit assayed 1.06, 0.44, and 0.12 ounces of gold a ton; these samples probably included the pyritized wall-rock and the two narrow veins mentioned above. Mr. Reinholt furnished the results of ten samples taken from this adit by the Consolidated Mining and Smelting Company in 1936. These varied from 0.01 to 0.51 ounce of gold a ton, the highest assay being from the narrow vein striking north 60 degrees west.

The No. 2 adit, about 50 feet below and 50 feet west of the No. 1, is caved and was not examined. It is described in the Annual Report of the Minister of Mines, B.C., 1929, page 194.

Sixty feet below the No. 2 adit and 75 feet to the west, a short adit has been driven on a vein one foot wide striking north 10 degrees east and dipping 70 degrees east. The vein contains a little pyrite and galena, and gold is stated to have been panned from the quartz. A transverse vein striking north 30 degrees east, exposed in an open cut immediately above this adit, could not be examined fully because the pit had caved. A vein up to 30 inches wide is exposed for a length of 10 feet, about 100 feet to the west. It strikes north 16 degrees east and dips 65 degrees west, crossing argillaceous schist. The quartz contains some disseminated pyrite and a little galena, and visible gold is reported.

Several parallel veins and lenses striking north 15 degrees east occur in argillaceous and graphitic schists and schistose quartzite on the top of the ridge, about 300 feet above the No. 1 adit. The largest of these is from 3 to 12

feet wide and is exposed for about 200 feet. The quartz is rusty, but appears to contain no sulphides.

Pauline Claim (19)

The large vein on the high part of the Jane group has been traced northward for a few feet into the adjoining Pauline claim. This claim is held by E. Lang and P. Gorrie, who each winter have extended an adit from the north slope of the ridge in an effort to locate the continuation of the vein.

Saddle Mines, Limited (20)

Saddle Mines, Limited, holds the Midas group of claims on the ridge between Little Snowshoe and French Snowshoe Creeks, about one-half mile east of Yanks Peak. The company is a private one, including O.J. Fickering, J. Glover, H.G. Heisterman, and E.L. Tait, a one-tenth interest being held by Britannia Mines, Limited.

The claims are covered extensively by shallow overburden. The rocks exposed are impure, schistose quartzite and quartz-sericite schist, containing rust and iron carbonate locally, and soft, fissile argillite and graphitic schist. A little schistose conglomerate is exposed near the northeastern extremity of the claims. The property is a short distance southwest of the anticlinal axis in the Richfield formation, the strata striking north 20 to 50 degrees west and dipping at various angles to the southwest. The beds are disturbed by minor folding, faulting, and fracturing.

The principal vein has an average width of about 4 feet, strikes north 10 degrees west, and dips at an average of 65 degrees east. It occupies a fault, with rusty weathering quartz-sericite schist at the hanging-wall and graphitic schist at the foot-wall. The wall-rock is sheared parallel to the vein, but judging by nearby outcrops the fault crosses the strata diagonally at a small angle. The vein is stripped on the surface for about 90 feet, and trenches farther north expose its probable continuation. An adit has been driven for about 600 feet in a southerly direction from the head of a small basin draining into Little Snowshoe Creek. The portal is 110 feet (barometric) below the principal outcrop of the vein. The adit intersected the fault 400 feet from the portal. The vein was encountered a short distance beyond the fault intersection and was followed almost to the face of the adit, where it either pinches out or is faulted. An inclined shaft was sunk from the main surface showing, following the vein down its dip and connecting with the adit 500 feet from the portal.

The vein contains small masses and fine disseminations of pyrite, and a little sphalerite, galena, and chalcopyrite. Fractures in the quartz parallel the walls, some of them containing small seams of sulphides. Visible gold is rare, most of the gold apparently being associated with the pyrite, which is most abundant in that part of the vein cut by the shaft. Lay¹ states that a sample of quartz well mineralized

¹Ann. Rept., Minister of Mines, B.C., 1934, pt. C, p. 30.

with pyrite, taken 30 feet below the collar of the shaft, across a width of 3 feet, assayed 3.4 ounces of gold a ton, and quotes² the following assays taken from the stripped surface of the vein:

²Op. cit., 1930, p. 176

Width 31 inches,	0.78 ounce of gold a ton.
Width 63 "	3.84 " "
Width 35 "	0.75 " "
Width 48 "	0.83 " "
Width 47 "	0.36 " "
Width 42 "	0.50 " "
Width 72 "	0.30 " "

Much surface trenching has been done to the east of the main or "Saddle" vein, exposing two groups of veins. The more westerly group, near the eastern boundary of the Saddle claim, consists of a number of small, irregular, bedded and transverse veins and lenses. About 600 feet farther east, chiefly on the Midas claim, the eastern group is exposed over a total width of some 300 feet, for about the full length of the claim. The veins are mostly small and lenticular, rarely more than 2 feet wide and 50 feet long. Many of them strike from north 80 degrees east to south 70 degrees east; others strike north 50 to 60 degrees east, transversely to the bedding. The veins contain some disseminated pyrite, and some display a little visible gold. A few assays are quoted in the Annual Report, Minister of Mines, B.C., 1929, page 194. The irregular character of these veins is no doubt due to the soft, incompetent nature of the sediments in which they occur, which yielded to stress by producing a number of small fractures.

It is possible that the Jane, Pauline, and Imperial veins, on properties to the north of the Midas group, lie in the same general zone as the "Saddle" vein. Bowman's map shows an adit on the "Steele and Cunningham" ledge on the north bank of

French Snowshoe Creek, at a point more or less on the strike of the "Saddle" vein. An unsuccessful search was made for this adit, and the prospectors of the district do not know its location.

Cariboo Yankee Belle Mining Company, Limited (21,22,23)

This property consists of five claims and four fractions on the south slope of Yanks Peak, extending from near the summit of the mountain to French Snowshoe Creek. The camp is at an elevation of 5,400 feet, and is about 12 miles by trail and road from Keithley Creek. Underground work was done a few years ago, but no work was in progress when the mine was visited in 1935 and 1936. Some underground work was done later.

Owing to overburden, rock exposures are practically confined to the workings, which lie south and west of the massive quartzite near the summit of Yanks Peak. The rocks exposed near the veins are chiefly impure, schistose quartzite and quartz-sericite schist, with some argillite and graphitic schist. These beds are somewhat disturbed, but the average strike is about north 20 degrees west and the average dip about 50 degrees west.

Veins are exposed at two principal localities, known as the Talbot and Corban sections of the property. The Talbot veins occur at an elevation of about 5,600 feet, near the northwestern extremity of the holdings. Several veins, from 1 to 3 feet wide, strike north 60 degrees east to due east, and gold assays are understood to have been obtained from some of them, but little work has yet been done on this part of the property.

The Corban veins outcrop about 1,500 feet southeast of the Talbot veins, at elevations of about 5,600 to 5,700 feet. There appear to be five transverse veins, up to 3.5 feet wide, occurring over a width of about 300 feet, exposed in opencuts and in three short adits. Owing to the possibility that some of the veins may be repeated by faulting, the exact number cannot be determined until the veins have been exposed at greater depth. The veins strike north 40 to 60 degrees east and dip 65 to 70 degrees southeast. The quartz is coarsely crystalline in places. It is rusty and contains some pyrite in disseminations and small nests, as well as many vugs from which pyrite was probably leached. Sampling suggests that the gold content is somewhat erratic, assays up to 4.24 ounces of gold a ton being reported.¹

¹ Ann. Rept., Minister of Mines, B.C., 1929, p. 193

An adit has been started near the camp buildings, to crosscut the Corban veins at depths of about 300 to 400 feet. This had been driven 765 feet when the property was examined, and was still about 600 feet from a point vertically below the nearest of the Corban veins. This adit encountered twenty-two transverse and diagonal veins and stringers that do not outcrop at the surface. These strike from north 33 degrees east to south 80 degrees east, and are either vertical or dipping steeply southeast. The largest vein is about 6 feet wide, many being less than 1 foot wide. Some are sparingly mineralized with pyrite and others are apparently barren, but as no drifting has been done only small sections of the veins are visible. The highest assays are understood to have been obtained from a vein encountered 685 feet from the portal. This vein has an average strike of north 80 degrees east. Its maximum width is 44 inches, consisting of quartz and inclusions of wall-rock, the quartz containing nests of pyrite and the schist containing pyrite cubes. Near the face the adit apparently penetrated a strong fault zone containing much brecciated quartz, but this part of the working is so lagged that it cannot be studied in detail. The veins occur at intervals of up to 30 feet. The intervening schists are much contorted and are traversed by small slips striking at different angles. The general strike of the foliation is north 10 to 20 degrees west and the general dip 40 to 50 degrees southwest.

Gold Recoveries (Cariboo), Limited (24)

This company holds the Blue Nose and Payroll groups of eight claims each, on the north shore of Cariboo Lake near the mouth of Kay Creek. The camp buildings are at the lake shore and the workings are reached by a short trail leading up Kay Creek. The property was idle when visited in 1935 and 1936.

A zone of bedded lenses and stringers of quartz in black, graphitic schist and buff, sericitic schist occurs on both sides of the creek at a point about 1,000 feet north of the lake and 130 feet above it. The zone strikes north 10 to 20 degrees west and apparently dips 50 degrees west. At the north-east side of the creek quartz up to 18 inches wide occurs at intervals over a total width of about 50 feet. On the opposite bank, quartz veins up to 3 feet wide occur over a total width of about 30 feet. The quartz is rusty and contains a little pyrite and galena. The wall-rock contains a little pyrite. The zone has been explored by means of an adit 45 feet long driven in the eastern wall of the creek gorge.

A zone of quartz veins, stringers, and lenses is exposed at the northeast side of the gorge, about 400 feet upstream from the zone already described. The rocks here are graphitic schists, too disturbed for a determination of their attitude. An adit about 50 feet long, driven in a direction north 20 degrees west, crosses obliquely a vein about 8 feet wide, which cannot be examined thoroughly because of timbering. At the face of the adit a crosscut has been driven 10 feet eastward, exposing a number of quartz stringers and lenses striking parallel to the foliation of the schist. Here quartz constitutes about 25 per cent of the zone. No sulphide minerals were seen in place, but samples on the dump containing pyrite and iron carbonate probably came from timbered parts of the vein. A zone approximately 30 feet wide exposed in the east bank of the creek immediately upstream from the adit consists of about equal proportions of schist and irregular masses of quartz in which no sulphides were noted. Both the schist and the quartz are too poorly exposed for the determination of attitudes.

Sylvain Claims (25)

The Sylvain claims are on the south slope of Nigger Mountain at elevations of 3,500 to 5,500 feet. The workings are reached by a steep trail that leaves the shore of Cariboo Lake midway between the mouth of Nigger Creek and the head of the lake. The rocks exposed are the typical altered quartzites and argillaceous sediments of the Richfield formation.

At an elevation of 4,550 feet, a bed vein about 15 feet wide strikes north 85 degrees west and dips about 35 degrees north. It occurs in fissile, grey quartzite, which here deviates from the average strike of the formation. The vein is exposed for a length of approximately 150 feet. The quartz contains some rust, but only a little unoxidized pyrite was seen.

About 500 feet to the west, a bed vein strikes north 70 degrees west, occurring in grey to black, schistose, argillaceous quartzite. The vein is vertical, is up to 5 feet wide, and has been traced for about 150 feet. The quartz is rusty and contains pits from which pyrite has been leached, but no pyrite was seen.

About 600 feet north, a bed vein 4 feet wide strikes north 40 degrees west and dips 35 to 55 degrees northwest. It occurs in schistose quartzite that is very argillaceous in places. It is exposed by a surface crosscut to a maximum depth of about 10 feet. The quartz is rusty in places and contains some yellowish mica, but no pyrite was seen.

Several other bed veins and many small stringers crossing the strata at various angles outcrop on the claims, but no sulphides were observed in them.

Sylvain and Langis Claims (26)

Dr. H.E. Langis and L. Sylvain hold seventeen claims on the southwestern slope of Harveys Creek Valley. Outcrops are very scarce, but a little rock has been uncovered by ground-sluicing. The limestone and schist so disclosed are probably the continuation of the basal part of the Hudson member of the Richfield formation.

At an elevation of about 4,000 feet on a small tributary of Harveys Creek a pyritic replacement in limestone strikes north 40 degrees west and dips 60 degrees northeast. Some pyrite occurs over a width of 9 feet, the more highly mineralized, central part of the zone being 1 foot wide and containing about 10 per cent pyrite. Mr. Sylvain stated that assays up to \$1.40 a ton in gold had been obtained. The zone is exposed in a pit 5 feet deep, for a length of 12 feet. No trenching was done in the deep overburden to the southeast. At the north end of the pit a dyke of fine-grained gabbro crosses the zone, striking north 70 degrees east. The dyke is 2 feet wide and contains a small amount of disseminated pyrite, an assay having indicated 65 cents a ton in gold. A ground-sluice 50 feet northwest, on the strike of the zone, failed to reveal either limestone or sulphides, suggesting that the limestone is either lenticular or faulted.

About 200 feet farther up the creek a zone about 2 feet wide contains a little pyrite in impure limestone. Immediately above this is a zone of apparently barren quartz stringers in schist. About fifty stringers up to 1 foot wide occur over a width of about 100 feet. Most of these are parallel to the bedding, but some cross the schists at various angles.

Placer Deposits

Placer mining has been active in Keithley Creek area since 1860. Although practically all the creeks of the area contain colours, workable placers have been found only in certain creeks traversing the Richfield formation. Antler, Keithley, Cunningham, and Harveys Creeks contributed an important amount of placer gold, which cannot be estimated because of the incompleteness of early records. Although the present yield does not compare with that of early operations, several properties are being worked. The possibilities for new discoveries have not

been exhausted, but the making of new finds has naturally become more difficult due to the extensiveness of previous prospecting.

Much of the rich gravel mined in the early days lay on bedrock at shallow depths below the present stream beds. Afterwards attention was devoted to deeper filled valleys, such as Snowshoe Creek, and to deposits of Tertiary and interglacial ages resting on bedrock benches and in ancient, high channels. Deposits of these three types include most of those being worked or prospected for today. As a rule these deposits are deeply buried, and their exploration requires much effort, either in shaft-sinking, drifting, drilling, or hydraulicking.

Antler Creek and Tributaries

The rich, shallow ground mined at Antler Creek in the early Sixties extended from Victorian Creek for about $1\frac{1}{2}$ miles downstream. So far as is known, comparatively little gold was found above Sawmill Flat. The only recent work consists of prospecting, by hydraulicking and drilling, on the north side of Antler Creek just above Sawmill Flat, done by Antler Placer Mines, Limited. Some gold was found in gravels resting on a series of rock benches, the gravels being overlain in places by two layers of boulder clay.

Sawmill Flat extends south from the bend of Antler Creek and joins a similar flat at the headwaters of Swift River. The gravels underlying these flats have not been thoroughly tested. Three drill holes and a shaft are reported to have indicated a low gold content.¹

¹ Johnston, W.A., and Uglow, W.L.: Op. cit., p. 56.

Nugget Gulch is reported to have been worked successfully by hydraulicking from 1906 to 1913. In 1935 and 1936 hydraulic prospecting was done by the Consolidated Mining and Smelting Company. Gravels overlying the south rim of the old pit were sluiced, but the gold content was stated to be below commercial grade. When the property was last visited, in 1936, hydraulicking was being continued toward a depression south of the pit, to test a theory that the depression might mark a buried channel.

Hydraulicking on a small scale has been done recently by J. Assortini on the lower part of California Creek and by Messrs. Calder and Liss at Wolfe Creek.

Three leases on Antler Creek near Whisky Flat, and adjoining leases in Cunningham Pass were drilled in 1923 and 1924, 1,500,000 cubic yards averaging 50 cents a yard and 3,000,000 cubic yards averaging 25 cents being estimated.¹

¹ Ann. Rept., Minister of Mines, B.C., 1924, p. 114.

A dredge was built in 1924 by the Kafue Copper Development Company, and operated until 1928. Recovery for 1925 is reported to have been \$95,066, the costs being about 10 cents a yard.² Figures for 1926 and 1927 were not published, but

² Idem, 1925, p. 146.

were probably lower as difficulties were encountered. In 1928 the dredge was abandoned in Cunningham Pass, the gold there being reported to occur practically all on or in limestone bedrock and, therefore, not recoverable by dredging.³

³ Idem, 1928, p. 188.

Cunningham Creek and Tributaries

Early work in Cunningham Creek consisted chiefly of mining on low benches along the present stream, extending from Palmer's bench, about 1 mile below Trehouse Creek to the Bear claims, near the mouth of Cunningham Pass Creek. Some early work was done near the mouth of Pearce Creek.

The principal recent work on Cunningham Creek has been at the Trehouse property, which has been worked hydraulically since 1923 at times when the supply of water permitted. The first work was on a rock bench east of and about 40 feet above the present creek. During the last few years a lower bench has been hydraulicked. This bench is about 200 feet wide and extends from the present creek to the rim of the higher bench. Bedrock is overlain by gravels, averaging about 9 feet thick, in which gold is stated to be fairly evenly distributed. This gold is said to be finer as a rule than that obtained from the higher bench, but to contain some pieces ranging from 50 cents to \$4 in value.

The Bear claim was hydraulicked mainly between about 1897 and 1908, when some gold was obtained on and near a rock bench only slightly above the present stream. Some hydraulic prospecting has been done recently.

Seven leases on lower Cunningham Creek were tested as possible dredging ground by the Coniagas Mines, Limited, in 1936. Gravels, about 3 to 10 feet thick, containing fine gold rest on bedrock in the bottom of a canyon 50 to 500 feet wide.

Keithley Creek and Tributaries

In the early days much gold was won from Keithley Creek between its mouth and Snowshoe Creek, gravels below the present stream and on benches having been mined by open work and drifting. One estimate places the production at about \$6,000,000.¹

¹ Ann. Rept., Minister of Mines, B.C., 1918, p. 143

F. Hunter, of Keithley Creek, stated that some gold was found between the mouths of Snowshoe and Rabbit Creeks and that little was found above Rabbit Creek or on Rabbit Creek itself.

Recent work near the mouth of Keithley Creek consists of drifting by A. Sutherland near the old Grotto pit, and by A. Watkins in an attempt to locate the outlet of a high channel.

A high channel of Keithley Creek on the Kitchener and Onward claims, below Four (Four Mile) Creek, was worked by drifting and hydraulicking between 1914 and 1927. Since 1930 Placer Engineers, Limited, have explored hydraulically the intersection of this high channel with an old channel of Four (Four Mile) Creek. Gold valued at about \$11,000 was obtained from a small bench at the intersection of the channels. The channels themselves were found to have been drifted by Chinese miners who entered from the present channel of Keithley Creek, using a bedrock drainage tunnel. The company has recently been exposing the Four channel in an effort to locate undrifted ground. Bedrock is overlain by 8 to 10 feet of stream gravels, succeeded by about 10 feet of stratified slum. The upper overburden consists of boulder clay and slum, the total thickness of overburden being about 300 feet.

An old channel of Keithley Creek about 50 feet north of the present stream and 20 feet above it is being drifted by Messrs. Johnson and Asserlind at a point about half a mile below Weave (Weaver) Creek. A small hydraulic plant has been worked

from time to time at the mouth of Weave (Weaver) Creek by F. de Long and others.

Messrs. Wade, Phillips, and Halon have recently hydraulicked a bench or high channel immediately west of the mouth of Snowshoe Creek, about 150 feet above the present stream. About 15 feet of gravels containing coarse gold rest on bedrock and are overlain by about 50 feet of hard boulder clay.

Some prospectors familiar with the district believe that part of the deep ground on Snowshoe and the lower parts of Little Snowshoe and French Snowshoe Creeks has not been mined. Old workings were extensive, but some of this drifting was probably not on bedrock, so that the deep ground on those creeks offers a speculative chance for prospecting by drilling or underground work. Messrs. Pickering and Glover have been sinking and drifting at Little Snowshoe Creek, finding gold on what is believed to be a "high run" resting on slum. For several years Messrs. Walton and Cameron have ground-sluiced on French Snowshoe about 2 miles above its mouth, obtaining coarse gold close to bedrock.

W. Hesbrouck operates a small hydraulic plant on Barr Creek, where 8 to 10 feet of shingled, gold-bearing gravels rest on bedrock practically at the level of the present stream.

Nigger Creek

Harvey Creek Minos, Limited, have been hydraulicking a buried channel near the mouth of Nigger Creek since 1933, reporting an annual production of about 200 ounces. Gold occurs in cemented gravels up to 20 feet thick, but most of the gold, which is fairly coarse, is recovered by hand from crevices in bedrock.

A recent discovery near the head of Nigger Creek is being ground-sluiced by Messrs. Baker and Peeling, using automatic boom-dams. Coarse gold, up to about 1-ounce nuggets, occurs in bedrock crevices and in gravels, in a narrow gutter about 3 feet below the present stream. Quartz veins containing nests of pyrite occur nearby. The deposit appears to be one that escaped glaciation, rather than one of Recent origin, and its discovery should encourage the search for similar deposits near the heads of the numerous other creeks nearby. A lower, adjoining lease is worked by Messrs. Hamilton and Kenvig.