PART C

ANNUAL REPORT

OF THE

MINISTER OF MINES

OF THE PROVINCE OF

BRITISH COLUMBIA

FOR THE

YEAR ENDED 31ST DECEMBER

1938

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BRITISH COLUMBIA DEPARTMENT OF MINES.

VICTORIA, B.C.

Hon. W. J. ASSELSTINE, *Minister.*

JOHN F. WALKER, *Deputy Minister.*

JAMES DICKSON, *Chief Inspector of Mines.*

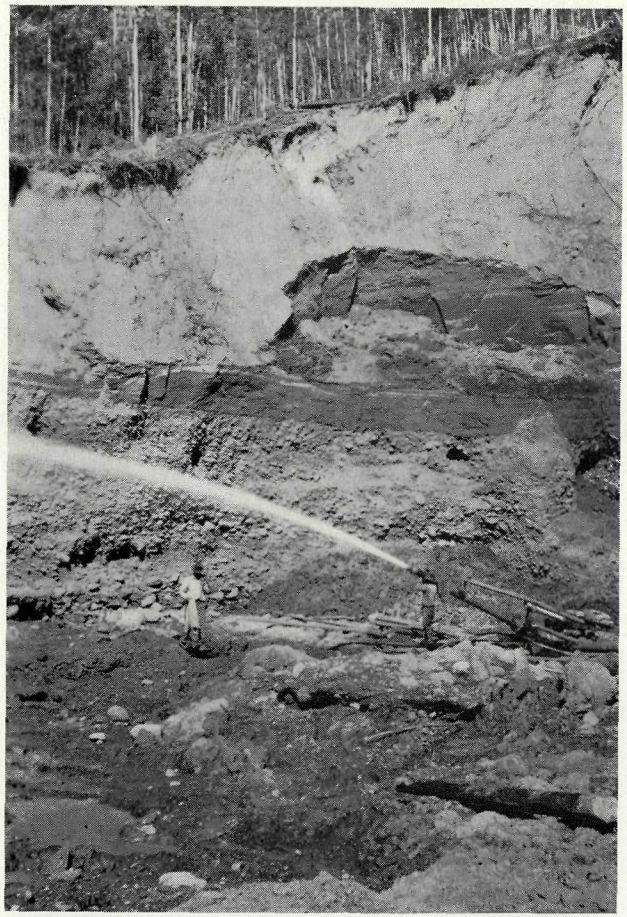
D. E. WHITTAKER, *Provincial Analyst and Assayer.*

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

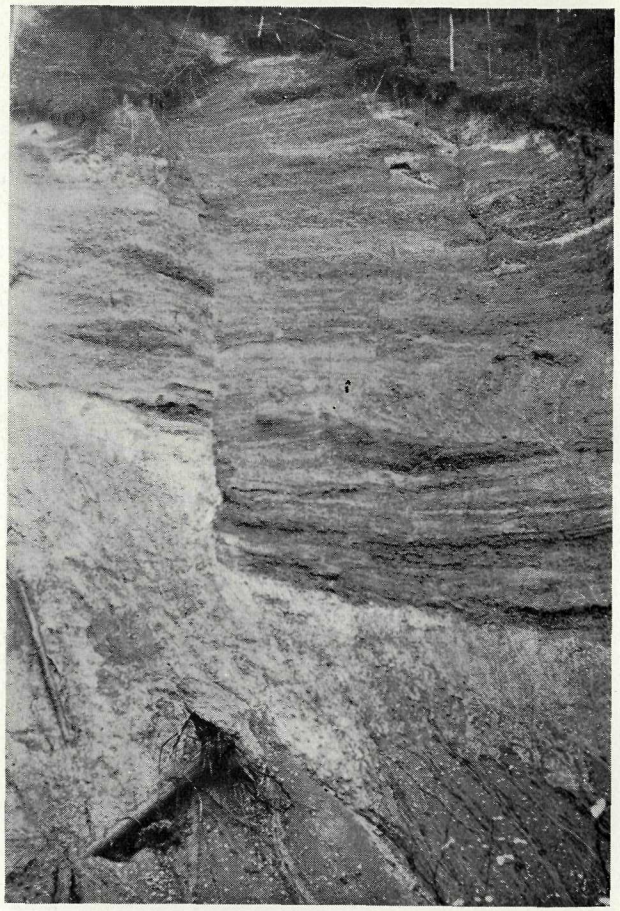
R. J. STEENSON, *Chief Gold Commissioner.*

Operation of Venture Exploration Company (East Africa), Ltd. Drag-line set-up at old townsite of Germansen.

Mobile digging and sluicing plant of Canamco, Ltd., in operation on Fraser River, 5 miles above Quesnel.



Operation of Germansen Mines, Ltd. Face of hydraulic pit on Germansen River.



Faulted Tertiary river-gravel on Baker Creek, near Quesnel.

PART C.

NORTH-EASTERN DISTRICT.

BY

DOUGLAS LAY.

SUMMARY.

During the year the chief activity centred on lode- and placer-gold properties. An increase in lode gold resulted from the steady operation of Cariboo Gold Quartz Mining Company, Limited, and Island Mountain Mines, Limited. The former company stepped up its daily milling rate to 275 tons, while the latter maintained its normal milling rate of about 125 tons daily. There was considerable activity in the area extending from Cow Mountain to Round Top Mountain and thence to Yanks Peak. With the provision of transportation facilities into this area greater activity is anticipated.

In the Hixon Creek area the Quesnelle Quartz Mining Company, Limited, installed a 25-ton test-mill for the purpose of sampling their property.

Lode-gold development in the Uslika-Aiken Lake area north-west of Manson Creek is awaiting transportation facilities which were commenced this year with the construction of about 70 miles of winter road.

The Cariboo district and Manson section experienced the driest season for very many years. It hampered both large and small placer operations and its effects will be reflected in the output.

This year marks the keenest search to date for dredging and drag-line properties. The interest is evinced almost solely by Californian interests, and there is every likelihood that possibilities in connection with such enterprises will be closely investigated.

A new type of drag-line plant, characterized by mobility, and a digging unit separate from the recovery unit was tried out in the Cariboo this year. This type of plant was evolved in California for use on areas with insufficient yardage to justify dredging and the results of the operation initiated in the Cariboo will be watched with interest.

In the Manson section large-scale hydraulic operations were carried out by Venture Exploration Company (East Africa), Limited, following completion of flume and ditch-line that conveys water from the upper part of the Germansen River to the company's property at the lower part of this river. Germansen Mines, Limited, planning material increase in hydraulic operations, commenced the construction of a large ditch-line—the largest in this district—to convey approximately 200 cubic feet of water per second from the South Fork of the Germansen River to the property. This ditch-line will be not less than 15 feet wide in the bottom, and is being dug by a bulldozer working in conjunction with a power-shovel.

After remaining inactive since 1922, the *Silver Standard* mine at Hazelton was reopened in May by Canadian Cadillac Gold Mines, Limited. Towards the end of the year, after cleaning out existing workings, renovating camp buildings, and repairing roads, the company installed an air-compressing plant.

A new development of interest is a cinnabar property at Pinchi Lake, near Fort St. James, staked by A. J. Ostrem, of Fort St. James. Discovery of this mineral was made by J. G. Gray, of the Geological Survey, Canada. (*See* Paper 38–14, 1938.) This is the first recorded occurrence of this mineral in place in the north-eastern part of the Province.

Considerable activity was manifested by individual operators in the Omineca Mining Division, and a number took advantage of the benefits accruing under the Government's ore-purchasing scheme, and made shipments to the sampling plant at Prince Rupert.

Coal-mining was carried on at the Bulkley Valley Colliery, near Telkwa.

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

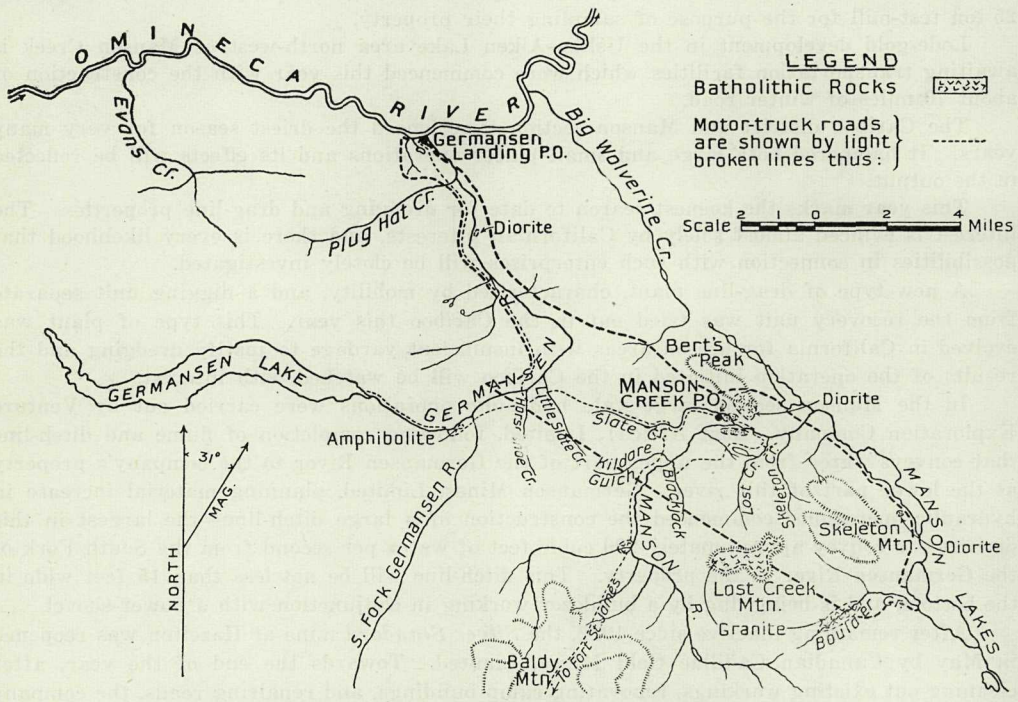
LODE-GOLD DEPOSITS.

Manson Creek Area.

Introduction.

Manson Creek area is defined to include the drainage areas of the Manson and Germansen Rivers. It excludes the Wolverine Range, which borders the area on the east. The area lies in the eastern part of the larger Manson section, a strip of country about 15 miles in width, that lies south of the Omineca River and extends from Takla Lake to the Manson Lakes.

Since the discovery of gold in 1869, mining activity in the Manson Creek area, as in the western part of the Manson section, has centred almost entirely on the placer deposits, to which it is still confined. However, a large number of quartz veins are exposed in the area, and as the placer deposits considered by themselves, although distributed by glaciation, indicate derivation from a local source, an examination of the chief exposures of the quartz veins was made during the year. This included a reconnaissance which throws considerable additional light upon two well-known apparent anomalies in placer occurrence; namely, the fact that important placer deposits are not found either on (*a*) the Manson River above Kildare Gulch, or (*b*) the north-eastward-flowing part of the Germansen River, with one exception.



Manson Creek Area. Heavy broken line bounds area examined in 1938.

The area examined is shown on the accompanying map and includes all the most important placer deposits in Manson Creek area, although placer occurrence is known on Big Wolverine (Jackfish) and Evans Creeks.

The area may be reached by the road now in course of construction between Fort St. James and Slate Creek, a distance of about 120 miles. The road is now passable throughout for motor-trucks and, in dry weather only, for passenger-cars with high clearance. The journey from Fort St. James occupies about twelve hours. At Slate Creek the road joins a local road system passable for cars, whereby all important properties are readily reached.

Alternatively, this area may be reached in about one hour by aeroplane from Fort St. James; good landings are offered by Germansen Lake and by the stretch of quiet water on

the Omineca River at Germansen Landing. Landings are also regularly made on the first Manson Lake, but events have demonstrated that landing on Wolverine Lake cannot advisedly be made.

There are two post-offices, Manson Creek on the right bank of Slate Creek, about half a mile above the mouth, and Germansen Landing on the Omineca River, at the mouth of the Germansen River. At both, there is a weekly mail delivery by aeroplane during the summer months, and at Germansen, the camp of Venture Exploration Company (East Africa), Limited, there is a telegraph-office.

Geological maps of the area, together with an account of the general geology and placer occurrence therein, are found in Geological Survey, Canada, Summary Reports, 1927 and 1933, Part A. A topographical map of the area, Manson River Sheet (East Half), Map 446A, was published this year by the Bureau of Geology and Topography, Department of Mines and Resources, Ottawa. The names of creeks and rivers in this report are those given in maps of the Department of Lands, British Columbia. Names in brackets after these are taken from Map 446A.

The Annual Reports, Minister of Mines, British Columbia, 1933 and 1936, contain a general account of the Manson section and detailed accounts of certain placer deposits on the Germansen and Manson Rivers.

Topography.

The area is mountainous, but the mountains, although reaching elevations of over 5,000 feet, have rounded or flat and rolling summits. Dissection by the contained streams is deep, the maximum relief exceeds 2,000 feet.

The pattern of the drainage system is remarkable. Both the Germansen and Manson Rivers occupy valleys, which form large U-bends, with the closed ends towards and within a few miles of each other. These valleys are connected by two wide valleys, Slate Creek and McCorkell Valleys. A wide master-valley, Big Wolverine Valley (Jackfish Creek Valley), connects the Manson River and Omineca River Valleys. The floor of Big Wolverine Valley (Jackfish Creek Valley) is actually 30 feet below the Manson River at the mouth of Dry Gulch. However, the lakes in it drain into the Manson, owing to the fact that the river falls away rapidly down-stream. The Big Wolverine (Jackfish Creek Valley) and Manson River Valleys form a straight continuous valley for over 20 miles.

The region is covered with heavy timber-growth and dense vegetation, save at the higher summits. Owing to the fact that the rivers and all their tributaries are involved, with all other Arctic-slope drainage, in the master-rejuvenation in progress on the Peace River, an extensive system of post-Glacial gorges and canyons has been incised. They reveal the formation at a number of points, and afford excellent cross-sections of it. Above the gorges the valleys are generally wide.

The area is flanked on the east by the more rugged and lofty Wolverine Range, to which it bears much the same topographic relationship that the Barkerville area does to the Cariboo Mountains.

Glacial Geology.

That an ice-sheet overrode the area is definitely proved by the fact that on the flat granite summit of the mountain at the head of Lost Creek (named "Lost Creek Mountain" on the accompanying map), at 5,300 feet elevation, erratics of black carbonaceous limestone were found. The indicated movement of the ice-sheet is therefore presumably south-eastward as this formation outcrops abundantly to the north-west. In the account of the formation flanking the Wolverine Range north of this point, given in Geological Survey, Canada, Summary Report, 1933, Part A, no mention is made of this black carbonaceous limestone, which, if present there, would indicate a southward movement of the ice-sheet.

The accumulation of ice was great; large volumes of water with correspondingly greater power, must have flowed during the retreats of ice. A striking instance of this is demonstrated on Boulder Creek. The valley of this creek is floored with enormous granite boulders (which, incidentally, are a great impediment in the way of working the good placer-ground on this creek), borne by the valley glacier from the large stock of granite at the upper reaches of the creek. Large pot-holes, several feet in diameter and depth, have been formed in some of the boulders in this assemblage by the post-Glacial water. The immense empty gorges incised on Government Creek, and adjacent to this on the right bank of Manson River

and at other points, also indicate the great carrying power of the post-Glacial streams. With such volumes of water flowing it is evident that any once-existent glacial debris has been partly removed from the lower-lying parts of the area.

Bed-rock Geology.

The area borders the eastern flank of the Eastern batholith, a granitic mass trending north-westward, and extending from the eastern part of the Cariboo district, through Mount Milligan and Baldy Mountain, and the headwaters of the Osilinka, Mesilinka, and Ingenika Rivers, to the Two Brothers Lake region. Close to this area it is deeply unroofed, and outcrops prominently and continuously for many miles south-east of this area to Mount Milligan and north-west across the Omineca River from Duck Creek onwards. In the south-eastern part of the area, that part enclosed by the U-bend of the Manson River, there are three large stocks and other smaller ones. This fact, coupled with the intense hydrothermal rock-alteration and recrystallization, can leave but little doubt that the remaining cover of roof-rocks is thin. The cover, so far as could be determined, probably increases in thickness in the north-western part, in the area drained by the Germansen River.

There is a noteworthy absence of any extensive dyking, but at a number of points definite evidence is afforded that the older rocks of the area are intruded by the batholithic rocks. Apparently intrusion to some considerable extent consisted in injection of magma along planes of schistosity, and recrystallization, accompanied by intense hydrothermal alteration of volcanic rocks.

Within the area examined there are belts of schistose sediments, hydrothermally-altered rocks, volcanic flow-rocks, tuffs, and serpentine. The sediments consist mainly of quartzite, fissile, grey and black carbonaceous limestone, and argillite. This assemblage is considered by the Geological Survey, Canada, to be of Palæozoic age. Much of the so-called "slate" of the area is black carbonaceous limestone that bears a strong superficial resemblance to slate, because of its highly-developed cleavage and colour. These rocks strike from north-west almost to west, and generally dip northward in the south-east part of the area, but on the Germansen River the dip is mainly southward and only occasionally northward. The dip is steep, generally over 60 degrees. Some members of the assemblage have undergone intense hydrothermal alteration and carbonatization and weather to a rusty-red colour. When so altered they may contain quartz and in places show large patches of a green-coloured mineral, chlorite. A number of samples of this green mineral were analysed and found to contain about 0.1 per cent. nickel. Frequently the altered rocks contain numerous quartz gash-veins, some of quite large size. Some of these veins are barren, some are mineralized with pyrite and small amounts of galena and sphalerite, and others mainly with tetrahedrite.

This alteration extends across wide bands, in some cases hundreds of feet in width. The excellent cross-sectional exposures of the formation afforded by the gorges incised by Manson and Germansen Rivers and by Lost Creek well illustrate the striking contrast between these rocks and the adjoining sediments and other rocks.

Some outcrops resemble dolomite, and contain magnesium and calcium carbonates. The igneous origin of the primary rock is, however, indicated by several exposures. On the right bank of the Manson River, near Elmore Gulch, exposures of andesite grade into a recrystallized form, merging finally in the highly-altered rock. On Boulder Creek chlorite schists merge in a highly-altered rock of the same type, in which small granite tongues are plainly visible. At the upper part of Government Creek, a band of serpentinized rock merges in the highly-altered rock.

It is therefore quite possible that some of these highly-altered bands may be in whole or in part sills. Exposures strongly suggestive of sills occur at the following points: On the right bank of Slate Creek, about 2 miles above the mouth, a band about 1,000 feet in width is exposed; in the north-eastward-flowing part of Germansen River; and in one of the hydraulic pits of Germansen Mines, Limited, where a band, only a few feet in width, conforms in strike and dip with the enclosing schistose argillite. At the first-mentioned point, the extensive display of green-coloured mineral is striking. Microscopic examination by the departmental staff indicated that such a rock might be hydrothermal alteration of, or vein-like material traversing, serpentinized ultrabasic rocks.

Many of these highly-altered rocks are medium to coarsely crystalline, and may be described as quartz-carbonate-chlorite rocks. On microscopic examination they are seen to be composed of quartz, ankeritic dolomite, and green chlorite. As previously mentioned, a number of samples of the green mineral were analysed and found to contain small amounts of nickel up to 0.18 per cent., which is suggestive of original identity as serpentine. The green-coloured mineral in these rocks is frequently mistaken for either garnierite or malachite.

Similar rocks on the south side of the Middle River are described and classified as altered intrusive serpentine in Geological Survey, Canada, Paper 38–10, 1938, pages 11 and 19.

Although the rocks described are undoubtedly the result of hydrothermal alteration, it is desired to point out that in Tertiary time, the percolation of ground water in the upper parts of serpentine would yield outcrops closely resembling dolomite. There are small deposits of calcareous magnesite tufa at the present time, on and near outcrops of serpentine, adjacent to the Germansen River. A sample from one of these was analysed and contained: Magnesia, 23.38 per cent.; lime, 18.66 per cent.

The limestone in the area, with the exception of one outcrop, is schistose, thinly bedded, and grey to black in colour. The black limestone is carbonaceous, and superficially simulates slate, in outcrops where cleavage is well developed. This limestone shows no evidence of hydrothermal alteration. The exception, massive limestone, is in a prominent outcrop on the left bank of Slate Creek, about 3 miles above the mouth. This outcrop is white in colour, finely crystalline, and contains a small amount of a green-coloured mineral of pearly lustre. This rock most closely resembles a sediment of all those observed containing the green mineral.

The evidence is, therefore, that these highly-altered rocks are *mostly* of igneous origin, either volcanic or intrusive.

Serpentine frequently occurs within the area; some is mineralized with pyrrhotite containing a small amount of nickel. It quite possibly results from the alteration of an ultrabasic intrusive. Other exposures are possibly alteration phases of ultrabasic flow-rocks. Asbestos is found in serpentine at the head of Elmore Gulch and in the lower canyon of Germansen River. Small deposits of calcareous magnesite tufa occur on the west valley-slope of the Germansen River at Mill Creek, and in the lower canyon

Quartz veins, although most numerous in the volcanic and hydrothermally-altered rocks, also occur in the sediments. They range in width from a few inches up to 16 feet. The largest veins observed are those on Boulder Creek. With few exceptions, the veins are lensy and discontinuous. Some are essentially of gash-vein type, having frozen walls and no regularity of strike or dip. Others strike and dip with the enclosing formation, or abruptly turn across it.

Many quartz veins are barren or nearly so; mineralization is heavy in only a few. The best mineralized veins are those exposed west of Blackjack Gulch, on the north-west slopes of Lost Creek Mountain, on the property formerly named *Black Hawk*.

The character of the mineralization divides the veins into three types: (1) Those mineralized with pyrite, galena, sphalerite, and chalcopyrite, or one or more of these minerals, as all are rarely present in any one exposure; (2) those containing chiefly tetrahedrite or a noticeable amount of this mineral; (3) those containing a pyrrhotite-sphalerite-galena mineralization confined to veins on one property, formerly named the *Black Hawk*.

The distinction between these three types is of fundamental importance, irrespective of the degree of mineralization, because it is only veins of type (2) that are pronouncedly auriferous. The other types were found to contain insignificant amounts of gold. Veins of type (2) were observed only in the highly-altered rocks. It is to be noted, however, that very little work has been done on the quartz veins, except in the case of one property, and at only two has a small amount of underground development been carried out.

The group of rocks, with its contained quartz veins, has undoubtedly a direct bearing on the placer deposits of the area. It supplied the gold for the formation of commercial placer deposits on bed-rock in Tertiary time, and may be correctly described as the "Manson Creek Gold Belt." In fact, the area well illustrates the interdependence of lode-gold and placer occurrence. The evidence of this is obscured, although by no means obliterated by the effects of glaciation.

Although examination during the present year was mostly confined to the area shown on the accompanying map, it is apparent that the width of this belt of rocks is limited in the south-eastern part of the area. On the north-east it is terminated by the Wolverine Range and on the south-west by a batholithic mass, which outcrops on both sides of the Manson River. In the north-western part of the area, between the upper canyon on Germansen River and a point about half a mile above Horseshoe Creek, massive greenstone outcrops on both sides of the river. This rock does not evince the same degree of metamorphism as the rocks of the "Manson Creek Gold Belt," and may be intrusive into them. Intercalated schistose, black carbonaceous limestone, and altered rocks are exposed at the head of the upper canyon of the Germansen River. The altered rocks contain small quartz veins. This assemblage resembles the rocks of the gold-bearing belt.

It is significant that the South Fork of the Germansen River (South Germansen River), contained in a valley of mature relief, apparently does not erode a gold-bearing terrain, as no important placer deposits are reported on it.

Summary.

The important points may be summarized thus:—

(1.) Of the large number of veins sampled, only a few contain appreciable gold values. These veins, with one exception on Slate Creek, occur at two different parts of the Germansen River: about 3,000 feet up-stream from the point at which the river turns sharply to the north-west; and near the head of the lower canyon, about 3½ miles above the mouth of the river. These veins are all of type (2) mentioned previously, that is they contain chiefly tetrahedrite, or a material amount of this mineral. They occur in highly-altered rocks, possibly in sills in the volcanic rocks.

(2.) Although no veins were found to carry commercial values, there seems every justification for close prospecting in the regions where distinctly encouraging values have been found in the mineralization exposed at the points indicated.

(3.) In general, the covering of the underlying batholithic rocks has been deeply eroded in the south-eastern part of the area, and therefore, aside from specific discoveries, the north-western part, where erosion does not appear to have removed such a thickness of cover-rocks, offers greater promise. In the south-eastern part, however, the south-eastern slopes of Skeleton Mountain are worth prospecting.

It is important to note that prospecting is greatly simplified by the fact that the conspicuous rusty-red outcrops reveal the promising host-rock. It merely remains to search such for quartz veins containing tetrahedrite.

(4.) All the placer-bearing streams of the area cut across the belt of schistose rocks, but unless the hydrothermally-altered bands, with their contained quartz veins, are cut, the placer deposits are unimportant. The Manson River above Kildare Gulch does not cut these bands and placer deposits are markedly less rich, whereas down-stream the altered bands are prominently exposed on both banks of the river, and some of the best placer deposits of the area were originally found in that part.

(5.) In the north-eastward-flowing part of the Germansen River, from a point about half a mile above Horseshoe Creek down-stream, the river cuts the gold-bearing formation, from which assays of samples of mineral gave good gold values, and yet, with one exception, the river is devoid of placer deposits. This anomaly is explained by the fact that this part of the river occupies a post-Glacial channel. A former channel, not cut by the river, is definitely indicated as lying buried in the left bank.

Quartz Veins.

A detailed account of the various veins examined is given in the paragraphs that follow. It should be noted that only ten mineral claims are in good standing at the present time in the entire area. No owner was on his property at the time of this examination. Consequently, from available information it is not possible to identify, with certainty, the present ownership of the exposures examined.

In all veins examined samples of *selected mineral* were taken in order that the contrast between the different types of veins might be emphasized. This point is of particular importance. The context shows that some additional samples were taken, where considered advisable, across full vein-widths.

Boulder Creek.

NOTE.—The following account adheres to creek nomenclature given in the Department of Lands map (and in the accompanying map). To avoid confusion, alternative names given in Map 446A are not inserted.

Boulder Creek rises in meadows in the wide pass between Lost Creek Mountain and Skeleton Mountain, and flows south-eastward into the third Manson Lake. Down-stream from the pass the gradient steepens, the valley narrows, and for part of its length the creek is contained in a gorge. Below the gorge the valley widens towards the point of mergence in the Manson River Valley.

About 2 miles above its mouth the creek receives a tributary, the South Fork, which flows north-eastward at the south-eastern base of Lost Creek Mountain. The volume of water in the South Fork is considerably in excess of that in Boulder Creek. Immediately above its junction with Boulder Creek, the South Fork is contained in a deep and narrow gorge, some hundreds of feet in depth, incised in granite. The granite intrudes the chlorite schist at the lower end of the gorge, which continues up-stream for more than half a mile. The granite in the South Fork Gorge is so jointed that it disintegrates in large cube-shaped masses, of which the talus slopes in the gorge are largely composed.

The formation is well exposed on Boulder Creek and consists of chlorite schist, which strikes from north 60 to 80 degrees west, and dips 60 degrees north-eastward. Rarely is the dip towards the south-west. The chlorite schist is intruded by small tongues of granite on the higher reaches of the creek, and shows intense metamorphism and a greater amount of chlorite. Granite also intrudes the formation on the South Fork.

The largest quartz veins observed in the Manson Creek area occur on Boulder Creek. The mineralization is confined to small bands, and is generally sparse, save in one instance. The mineralization is chiefly galena and pyrite, but one or two veins contain a small amount of chalcopyrite. No pronounced gold values were found in the mineral in these veins. All vein-exposures examined are on the banks close to the creek.

About a quarter of a mile down-stream from the junction of the South Fork, on the left bank of the creek, a large quartz vein of maximum width of 10 feet is exposed for a length of 180 feet along its strike. This vein has free walls, and conforms in strike and dip with the enclosing chlorite schist, which at this point strikes north 56 degrees west and dips 60 degrees to the north-east. This vein, the largest continuous exposure of quartz observed in the area, shows little mineral.

On the same side of the creek, 1,500 feet below the junction of the South Fork, a quartz vein 5 feet in width is exposed for a short distance. It strikes north 86 degrees east, dips 65 degrees south, and cuts across the chlorite schist. It contains muscovite but no sulphides.

On the right bank of the creek, about 1¾ miles above its mouth, there is a small rock knoll about 40 feet in height, and whose dimensions at the top are about 75 by 50 feet. Three intersecting quartz veins outcrop on the apex and sides. The largest, 12 feet in width, has a vertical dip, strikes north 69 degrees west, and is exposed at the top of the knoll for a length of 50 feet. It intersects another quartz vein about 5 feet in width that outcrops on the east side of the knoll, strikes north 61 degrees east and dips north-west. This latter vein is intersected by a small quartz vein, 12 to 18 inches in width, also outcropping on the eastern side of the knoll. The two larger veins are oxidized and show no material amount of sulphides. The smallest vein contains a band of galena about 2 inches in width, a sample of which assayed: Gold, trace; silver, 30 oz. per ton; lead, 48 per cent. The walls of these veins are mainly free.

There is a caved open-cut on the left bank of the creek about 700 feet down-stream from the last-mentioned exposure. It is in highly-oxidized rock. Beside the open-cut is a small pile of little pieces of massive pyrite containing galena, somewhat suggestive of replacement mineralization. A sample of this assayed: Gold, trace; silver, 1.4 oz. per ton; copper, *nil;* lead, 3 per cent.

Down-stream 660 feet from the last exposure, on the left bank of the creek, a vein 5.5 feet in width conforming in strike and dip with the enclosing chlorite schist is exposed by natural agencies and one open-cut for 50 feet along its strike. Mineralization consists of pyrite and galena. A sample taken from the open-cut across a width of 2.5 feet assayed: Gold, trace; silver, 4.4 oz. per ton; copper, *nil;* lead, 4 per cent.

About 750 feet down-stream from the last exposure, on the right bank of the creek, on the face of a steep rock-bluff, natural exposures aided by open-cutting and stripping 35 feet above creek-level expose a quartz vein along its dip. The vein is 12 to 16 feet in width, strikes north 43 degrees east, dips 60 degrees south-east, and cuts across the enclosing chlorite schist, which strikes north 80 degrees west and dips 60 degrees north. It is oxidized, has free walls, is exposed along its dip over a vertical range of 40 feet, and is accessible only at the level of the open-cut. Mineralization consists chiefly of galena with some pyrite, and is more abundant in the open-cut. A chip sample taken across 12 feet assayed: Gold, trace; silver, 15.5 oz. per ton; lead, 3.2 per cent. However, in the absence of further investigation this sample cannot be taken as representing the average vein-width.

Adjoining the vein on the hanging-wall side for a distance of 75 feet, there is a succession of closely-spaced lensy quartz veins, which in part follow and in part cut across the planes of schistosity of the enclosing formation. Some of these veins contain small bands 3 inches in width chiefly of galena, but the total amount of mineral present is small. A sample of one of these bands assayed: Gold, 0.04 oz. per ton; silver, 75.6 oz. per ton; lead, 36 per cent. The samples taken indicate that although only low gold values are present, the silver-lead ratio is noteworthy.

Lost Creek.

Lost Creek rises in a large basin on the north slopes of Lost Creek Mountain and flows northward. The basin becomes gorge-like at its lower extremity, and from it the creek emerges to flow across a wide depression trending east and west across the mountain. It then enters a lower gorge, the rims of which rise abruptly from the depression. The lower gorge is roughly 5,800 feet long. It ends abruptly at the instream edge of an extensive rock-bench along the right bank of the Manson River.

The rock exposed in the upper gorge is argillite. In the lower gorge bands of hydrothermally-altered rocks alternate with bands of grey to black fissile limestone and argillite. Some apparently barren lensy quartz veins up to 5 feet in width are exposed at several points. Lensy quartz veins mineralized with a little galena and pyrite outcrop at a point 440 feet up-stream from the mouth of the creek, on the steep west rim of the lower gorge. Three lenticular quartz veins are exposed by a caved open-cut at a point 100 feet above creek-level, on the steep west rim of the gorge. They occur in hydrothermally-altered rocks, strike north 62 degrees west and dip 70 degrees north-east. They range in width from 6 to 30 inches and are sparsely mineralized with galena and pyrite. A sample of selected mineral assayed: Gold, trace; silver, 0.6 oz. per ton. An adjoining open-cut a few feet above this point exposes two veins of irregular strike for a length of 18 feet. They are only a few feet apart, and range in width from 14 to 34 inches. Distant 138 feet in a direction due east, another open-cut exposes a vein with a vertical dip. It ranges from 15 inches to 3 feet in width, and has two small spurs. Small bunches of galena have been found in this vein, and there is a small pile of mineral at the mouth of the open-cut. A sample of mineral assayed: Gold, trace; silver, 10.2; lead, 18 per cent. A few feet above creek-level below these open-cuts, a short adit 20 feet in length, driven by placer-miners, exposes a small quartz vein 4 inches in width. A sample of this assayed: Gold, trace; silver, 0.8 oz. per ton.

A number of quartz lenses are exposed at different points in the schistose sediments on Manson River between Slate Creek and Dry Gulch. Most of them are barren. On the right bank of the river opposite the mouth of Dry Gulch are several oxidized quartz veins which contain a small amount of pyrite. They conform in strike and dip with the enclosing argillite and range in width from 1 to 3½ feet. Samples were taken from two of the best mineralized of these, and assayed: Gold, *nil;* silver, *nil.*

Lost Creek Mountain.

Lost Creek Mountain is one of the highest mountains in the area, the elevation of the flat rolling summit, composed wholly of granite, is 5,300 feet.

A group of claims, formerly named *Black Hawk* group, and formerly owned by Germansen Development Syndicate, Limited, now defunct, is west of Blackjack Gulch, on the north-western slopes of Lost Creek Mountain. The present ownership is not known. It is reached by following the wagon-road from the end of the motor-road at Mosquito Lake to Blackjack Gulch, whence a trail, 1½ miles in length, ascends the 20-degree mountain-slope to a cabin on the property at 4,125 feet elevation.

Near all the mineral showings save one, the mountain slopes at about 10 degrees, but falls away more sharply in the region of the lowest showing. It is covered with light timber-growth and dense vegetation.

A number of quartz veins, ranging in width from 15 inches to 5 feet, occur within a belt 650 feet wide. Six of these strike north-eastward, with steep dips either to the south-east or to the north-west. One vein strikes west of north with a north-east dip. Strike and dip of two other veins are not determinate from the exposure. Another exposure may be of one quartz vein or two lenses *en echelon*. The vein-walls are free, and generally the veins are well-mineralized; in two, the mineralization is heavy. The mineralization consists chiefly of pyrrhotite with smaller amounts of pyrite, galena, and sphalerite. Gold values are insignificant, but the amount of silver associated with this mineralization is unusually high. This type of mineralization was observed nowhere else in the area. The host-rock is massive recrystallized andesite.

The early history of this property is not known to the writer, but the age of the cabin on the ground indicates that it must have been staked many years ago. It was restaked in 1931, and Germansen Development Syndicate, Limited, was incorporated in that year for the development of it and other properties in the Manson Creek area. The company, in 1931, cleared out and extended some of the open-cuts, but let the property lapse. It is believed to have been subsequently restaked, but from the information available the present ownership is not known.

The surface showings all lie between elevations of 4,120 and 4,185 feet. Two veins are exposed naturally, and the remaining exposures are in open-cuts or surface-stripping.

The showings all lie in a south-westerly direction from a short adit which is a convenient reference point and is the only underground working.

The adit, 18 feet in length, is driven at elevation 4,135 feet on a bearing of south 23 degrees west. It follows a well-mineralized quartz vein 18 inches in width, which is exposed at the portal and which dips at a steep angle to the north-east. At the face, other small quartz stringers are exposed, together with the vein which has narrowed to a stringer 3 inches wide. Mineralization in the vein at the portal is locally heavy, and consists chiefly of pyrrhotite and pyrite, with a small amount of sphalerite. A sample of selected pieces of mineral from a small pile at the portal of the adit assayed: Gold, 0.02 oz. per ton; silver, 43.6 oz. per ton; copper, *nil;* lead, *nil;* nickel, *nil.*

A quartz vein 18 inches in width outcrops at 4,155 feet elevation and 18 feet in a direction south 79 degrees west from a point vertically above the face of the adit. It is sparingly mineralized with pyrite and pyrrhotite. Strike and dip are not clear from the small exposure.

Distant 72 feet in a direction south 79 degrees west from a point vertically above the face of the adit, at 4,155 feet elevation, an open-cut 2 feet deep and 6 feet long exposes small bodies of slightly mineralized quartz at each end. They might be two parallel veins, each about 3 feet in width, striking north 11 degrees east, dipping steeply easterly, or quartz lenses occurring *en echelon.*

Distant 15 feet in a direction south 79 degrees west from the last open-cut, at the same elevation, surface-stripping exposes for a distance of 21 feet along its strike a quartz vein striking north 19 degrees west and dipping steeply north-eastward. The exposed width ranges from 3.5 feet to 5 feet, but both walls are not exposed at any point and the average width may be 5 feet. This vein is well mineralized with pyrrhotite, pyrite, galena, and sphalerite. It is considerably oxidized, and the walls are free. A sample across a width of 5 feet at the point of best mineralization assayed: Gold, trace; silver, 40.8 oz. per ton; copper, *nil;* lead, 3 per cent.; zinc, 3 per cent.; nickel, *nil.* Another sample taken across 3.5 feet at a point 8 feet north-west of the last sample, assayed: Gold, trace; silver, 4 oz. per ton; copper, *nil;* lead, *nil.*

Distant 245 feet in a direction south 70 degrees west, an open-cut at 4,180 feet elevation, 40 feet in length and 10 feet deep at the face, is driven on a bearing south 19 degrees west. A few feet from the mouth the open-cut intersects and subsequently follows a well-mineralized quartz vein, strike north 31 degrees east, dip 78 degrees south-east. Where encountered the vein is 3 feet in width but narrows to 19 inches at the face of the open-cut. For 33 feet beyond the face the vein is exposed by surface-stripping. Its average width is 19 inches and it is heavily mineralized, chiefly with massive pyrrhotite. A sample representative of the

most heavily mineralized parts of the vein, taken at different points along its strike, assayed: Gold, trace; silver, 3.4 oz. per ton; copper, *nil;* nickel, *nil.*

Distant 120 feet in a direction south 87 degrees west from the last-described open-cut, at 4,185 feet elevation, a quartz vein 18 inches in width, somewhat oxidized and sparsely mineralized, is exposed for a few feet along its strike by surface-stripping. This vein strikes north 31 degrees east and dips south-east at a steep angle. The south-west continuation of the vein is apparently exposed by two open-cuts, respectively 45 feet and 70 feet from the surface-stripping. Of these open-cuts the former, now much caved, exposes the vein for a distance of 10 feet along its strike, at a point where its width is 4.5 feet. In it the vein is honeycombed, and well mineralized with pyrrhotite and some sphalerite. A sample of selected pieces of the mineral exposed assayed: Gold, *nil;* silver, *nil;* copper, *nil.* This open-cut exposes another vein lying a few feet to the north-west, of similar strike dipping north-west and 15 inches wide. The open-cut at a distance of 70 feet from the surface-stripping is much caved but exposes a south-eastward dipping vein.

A small body of quartz outcrops at 4,120 feet elevation and 228 feet in a direction north 60 degrees west from the surface-stripping last mentioned. The exposure is small but may represent an unmineralized vein about 3.5 feet in width. Strike and dip are not clearly indicated.

Slate Creek.

A property formerly named *Fairview* and formerly owned by T. Rush, of Prince George, the present ownership of which cannot be identified by the writer from available information, is on the left bank of Slate Creek, about a mile above its mouth. The wagon-road leading from Slate Creek through the McCorkell Valley to the Germansen River passes through the property, and the distance from Manson Creek post-office is about three-quarters of a mile.

The property lies on the lightly-timbered, gently-sloping left rim of Slate Creek Valley. The formation exposed at this point is hydrothermally-altered andesite which contains narrow lensy quartz veins. One of them increases in width from 1.5 feet to a maximum of 6 feet and then narrows to 1.5 feet. It outcrops at various points on the gently-sloping valley-rim. It is irregularly mineralized with chalcopyrite, tetrahedrite, azurite, malachite, and a green-coloured mineral, chromiferous chlorite. A similar green mineral is also prevalent in the host-rock. This vein strikes from north 44 degrees west to north 14 degrees west and dips almost vertically. The walls are partly free, partly frozen. The vein is exposed by two trenches running along its strike. One trench is 30 feet in length, 5 feet in width, and a maximum depth of 10 feet. It is on a bearing of north 44 degrees west, and exposes the vein more or less continuously for 30 feet, the maximum width is 1.5 feet. A gap of 15 feet separates the first from the second, the length of which is 89 feet, depth 3 to 10 feet, width 5 feet, and bearing north 14 degrees west. In the central part of the second, the quartz vein swells to a maximum width of 6 feet, which is maintained for only a few feet and then narrows to 1.5 feet. The best mineralization occurs at the wide point, although it is patchy, and the percentage of mineral in the whole vein is small. The trench beyond the wide point of the vein exposes poorly mineralized quartz 1.5 feet wide for a distance of 29 feet. A sample of selected mineral from the best mineralized part of the vein assayed: Gold, 0.28 oz. per ton; silver, 22.3 oz. per ton; copper, 1 per cent. A long trench in a north-easterly direction does not expose the vein.

Although no exposure at this property is commercial, the fact is brought out that it is the veins of type (2) in the altered rocks, and containing tetrahedrite, that carry appreciable gold values in the Manson Creek area. The advisability of further prospecting in this region is indicated.

Germansen River.

Transportation routes in this region are described in detail in the Annual Report, Minister of Mines, British Columbia, 1936.

Appreciable gold values in mineral in quartz veins of type (2) have been found in two parts of the Germansen River.

(*a.*) On both sides of the Germansen, where it makes a sharp local bend, about 3,000 feet from the down-stream end of the north-eastward-flowing part. The river cuts a wide band of hydrothermally-altered rocks containing abundant chlorite. The altered rock at

some points strongly resembles a quartz-feldspar intrusive. On the left bank of the river at this point occurs a ramification of quartz gash-veins of various widths and of irregular strikes and dips. The largest of these veins is 5 feet wide. The veins are only slightly mineralized with tetrahedrite and stained with malachite. Very little work has been done at this outcrop. A sample of selected mineral, taken by the writer from these veins at this point in 1931, assayed: Gold, 0.44 oz. per ton; silver, 47 oz. per ton; copper, 1 per cent. A group was staked at this point, named the *Mother Lode* group, in 1931 by the now defunct Germansen Development Syndicate, Limited.

Several small quartz veins are exposed on the opposite side of the river, about 300 feet down-stream from this point on a claim formerly known as the *Flagstaff*. From one, 15 inches in width, a sample of selected mineral taken by the writer in 1931 assayed: Gold, 0.10 oz. per ton; silver, 18 oz. per ton; copper, 1 per cent. Mineralization is tetrahedrite with malachite staining. A sample of float picked up on the steep bank of the river below these veins assayed: Gold, 0.6 oz. per ton; silver, 38 oz. per ton; copper, 5.1 per cent. Mineralization consisted essentially of tetrahedrite.

(*b.*) In the north-westward-flowing part of the river, near the head of the lower canyon, about 3½ miles above the mouth of the river. Near an intrusion of diorite a wide bank of volcanic rocks shows considerable shearing and local intense serpentinization. A group of claims in this region was examined in 1931, and the report thereon, published in "Lode-gold Deposits of British Columbia," Bulletin No. 1, 1932, is reproduced herein:—

"Three intensely altered and silicified zones, each about 12 feet in width and about 500 feet apart, strike in a north-west and south-east direction and can be discerned on both sides of the river. Within these altered zones are developed quartz veins, which show a mineralization of chalcopyrite, grey copper (tetrahedrite), and malachite, with promising values in gold, although no noteworthy vein-continuity is apparent.

"On the east side of the river, about 100 feet above the river, one of the altered zones mentioned shows a quartz vein 2 feet in width, mineralized with grey copper (tetrahedrite), chalcopyrite, and malachite. A sample across 2 feet assayed: Gold, 0.8 oz. to the ton; silver, 1.6 oz. to the ton; copper, 0.2 per cent. Exposure is by open-cut. The vein strikes north 39 degrees west and dips steeply north-east. A sample of a small pile of ore lying by the open-cut assayed: Gold, 0.32 oz. to the ton; silver, 15.2 oz. to the ton; copper, 0.4 per cent. About 40 feet vertically below the open-cut, a crosscut-adit, 62 feet in length, run on a bearing north 41 degrees east, passes through a quartz vein 5.5 feet in width, which may be the downward continuation of the vein exposed by the open-cut mentioned, but this shows but little mineral and a sample across the full width of the vein assayed traces only of gold, silver, and copper.

"On the east side of the river, and 575 feet above the latter, an adit 15 feet in length preceded by 20 feet of open-cut is run on a bearing north 66 degrees east, crosscutting one of the altered zones previously referred to. This exposure shows a certain amount of quartz with a little chalcopyrite. A sample of a small pile of mineral lying by this working assayed: Gold, 0.30 oz. to the ton; silver, 0.1 oz. to the ton; copper, trace.

"Distant from the above working about 3,000 feet in a north-west direction, and 135 feet below it, an altered zone 11 feet in width shows a width of 5 feet of quartz and brecciated country-rock, but little mineral is in evidence.

"On the opposite side of the river, at a slightly higher elevation, in the same altered zone, an adit has been run a distance of 21 feet in the zone, bending to the right at the face and passing apparently out of the zone. Silicification and alteration of the country-rock is intense in the zone, and a green mineral apparently chlorite is much in evidence, together with a little malachite. A sample from the adit across a width of 2 feet at the most promising-looking place disclosed a trace only of copper, and no gold, silver, or nickel values."

On the left bank of the river, just below the junction of Plug Hat Creek, there is exposed a large quartz vein 10 to 12 feet in width, which appears to conform in strike and dip with the enclosing schistose sediments, although the latter are cut by numerous spurs of the vein. This vein was formerly covered by the *Sunset* group, which has now lapsed. A report thereon, published in "Lode-gold Deposits of British Columbia, Bulletin No. 1, 1932," is reproduced herein:—

"The vein is sparsely mineralized with pyrite, chalcopyrite, and copper-stain. The foot-wall is a carbonaceous schist and an adit just above water-level follows the vein for a distance of 120 feet. For the first 45 feet the bearing is north 82 degrees west, and for the remaining distance the bearing is south 56 degrees west. The adit exposes the foot-wall rock for almost the entire distance, but it is doubtful if the full vein-width is exposed. At the face of the adit the vein appears to be mainly in the back. A sample of selected portion of mineral assayed: Gold, trace; silver, 0.6 oz. to the ton; copper, 1 per cent."

Bearing of this Examination on Placer Occurrence.—The following facts disclosed by this examination have an important bearing on placer occurrence in the area:—

(1.) Certain topographic features on the Germansen River, not previously known, came to light, and are considered to have an important bearing on placer occurrence on this river. They are:—

(*a.*) North of Plug Hat Creek, a large depression, the lower part of which is occupied by Harding Creek and a morainal lake, trends more or less parallel to the Germansen River. The depression merges northward in the flat terrain flanking the Omineca River, but southward becomes pronounced, and about half a mile west of the river, ellipsoidal outcrops of volcanic rock form its west rim. This large depression with its westerly rock rim is considered an important feature and its presence may assist in localizing the down-stream continuation of the intricate buried former channel-system of the Germansen River.

(*b.*) Just up-stream from, and opposite, Mill Creek, at the upper end of the placer-mining lease of Chester Scott, at an elevation of 330 feet above the river, a very definite depression, about 300 feet in width, bounded by high rock-rims, passes entirely outside and east of the present valley of the river, and again joins it at the head of the lower canyon. This is definitely an early channel-segment of the river. Its length is about 1¼ miles, and its original down-stream continuation undoubtedly lay west of the canyon.

(2.) It is desired to amplify reasons previously given for the paucity of important placer deposits on the Manson River above Kildare Gulch and on the north-eastward-flowing part of the Germansen River.

An examination was made of the north-west slopes of Lost Creek Mountain to a point 3 miles above Kildare Gulch. This disclosed that although the formation consists of alternating bands of volcanic rocks and argillite, the former are massive rather than schistose. These volcanics do not exhibit the hydrothermal alteration which characterizes not only the host-rocks containing the quartz veins with mineral of pronounced auriferous content, but which is also the formation eroded where the best placer deposits are found. Further, it was apparent that the region is close to the main batholithic mass.

With reference to the paucity of placer in the north-eastward-flowing part of the Germansen River, down-stream from Horseshoe Creek: This examination disclosed that the formation eroded is of distinct promise for the discovery of auriferous quartz veins. There is every reason to anticipate that in the absence of ice-scour, gold-bearing bed-rock gravels would be found in a Tertiary channel incised in such formation. The paucity of placer deposits is readily explained by the fact that the present channel of the river in this region is definitely not of Tertiary age. Local topographic features indicate that an extensive segment of a former channel lies buried in the left bank of the river. This buried channel may not be older than Pleistocene. The Germansen River in this region now occupies a channel completed in post-Glacial time, although incision may have commenced in the Pleistocene.

(3.) It is desired to draw attention to the significance of the points at which mineral of pronounced gold content occurs in veins, in relation to any buried channel system there existent. This is particularly evident in the north-eastward-flowing part of the river, down-stream from Horseshoe Creek, and in the north-westward-flowing part of the river, near the lower canyon. In the latter case the argument appears to apply with particular force, inasmuch as there is much to suggest that west of the canyon in this region the members of the intricate buried channel system are likely to unite.

PLACER-GOLD DEPOSITS.

Horsefly Area.

Introduction.

Horsefly is reached by a motor-road 31 miles in length, branching from the Cariboo Highway half a mile north of the 153-mile House; the distance from Williams Lake is 45 miles. There is a good system of local motor-roads in the area that gives access to all the more important properties.

The size and undoubted antiquity of the deposits of residual "white channel" gravel, composed largely of quartz pebbles, contained in the several exposures of the buried ancient Horsefly River drainage system, has long aroused much interest. The age of these deposits has been definitely established at points where they are buried under Tertiary volcanic flows.

Some possible connection between the seemingly detached placer deposits of the *Miocene*, *Ward's Horsefly*, and *Hobson's Horsefly* mines, on which all important history of the area centres, was sought at the time these properties were operated about forty years ago. It has since been the subject of discussion, although no major activity has subsequently taken place in this area.

It is apparent that these ancient gravel deposits—similar to the "white channel" gravel of the unglaciated Klondyke—invest this area with more than local interest. Apart from their commercial significance, their antiquity brings up the question of the course of the river in which they were deposited, at points far down-stream from Horsefly. As the direction of flow of the large tributaries of the Fraser River—namely, the Quesnel, Cottonwood, Willow, Bowron, West Road (Blackwater), and Chilako Rivers—is not in accord with that of their present parent stream, a possible reversal of drainage in the Fraser River Valley is suggested. It is therefore a rational hypothesis that in early Tertiary time a river, possibly the Horsefly River, may have flowed northward in or adjacent to the present Fraser River Valley, as a tributary of the antecedent Peace River. It is apparent that the latter is now in active rejuvenation as far as Summit Lake north of Prince George.

During the year, about six weeks was occupied in a general reconnaissance of the Horsefly River, as far as the mouth of its tributary the Mackay River (formerly named the South Fork); and of McKinley Creek, including Elbow, McKee, and Crooked Lakes. The more important placer deposits were examined in detail.

As the result of this examination new and important facts were brought to light, but for reasons made clear subsequently, the buried drainage system is involved. Although its broad outline can readily be perceived, many details cannot be determined in the course of field-work. Many important facts regarding the *Miocene*, *Ward's Horsefly*, and *Hobson's Horsefly* mines are not given in existing accounts of these old operations, and now cannot be obtained. Consequently, certain inferences are supported only by indirect evidence.

Summary.

For clarity, an outline of the Horsefly River drainage pattern is first given, followed by a summary of the inferences conveyed by the more important facts ascertained by field-work. Details follow in the body of the report.

In its broadest aspects, the drainage is by a large river flowing in a region of low relief. It turns unexpectedly, at right angles to its former course, at a point near Horsefly. The turning-point is where the upper end of the large valley of Beaver Creek, the dominating feature of the surrounding topography, virtually merges in the Horsefly River Valley. The inference is that the Tertiary channel of the Horsefly River lies buried in, or closely adjacent to, the Beaver Creek Valley.

Although the facts indicate that this view is substantially correct, they also indicate that the abrupt turn is not due to damming by glacial debris, as might appear at first, but to volcanism in Tertiary time.

It is further apparent that there were two different periods of volcanism. Following each, lava dams caused the river to occupy a local course different from its former channel.

The difficulty of deciphering the buried drainage system is further increased by changes attributable to the Glacial epoch, when temporary channels, differing from those now occupied, were successively followed owing to damming by glacial debris.

Summary of the important conclusions: In Eocene or earlier time, the Horsefly River, down-stream from Woodjam Creek, flowed in a valley which was continuous with that of Beaver Creek. This former valley continuation, between that part of the river-valley above Woodjam Creek and the upper end of Beaver Creek Valley, is now obscured by the Tertiary formation underlying the elevated plateau on the left bank of the river and at the head of Beaver Creek Valley.

Prolonged erosion of gold-bearing terrain in Eocene or earlier time was interrupted by volcanic eruptions that dammed the part of the valley mentioned above, and caused the river to deviate locally from its former channel. This damming is expressed by the Tertiary formation mentioned in the previous paragraph. Lakes were formed, probably by actual damming by erupted lava. A feature of the volcanism was the enormous quantity of volcanic ash that was deposited in the lakes, producing tuff beds of great thickness.

Contorted beds are overlain by flat-lying beds. It is evident that there were two periods of tuff deposition and that contortion of beds followed the first period, whereas no great disturbance followed the second.

As the result of volcanism, the valley down-stream from Woodjam Creek was blocked with lava. Finally the river worked its way round the obstruction, now expressed in the form of an elevated plateau, and presumably rejoined its former course in the Beaver Creek Valley. Evidence now remains of only a part of the deviated course of the river at the time. This is afforded by the *Miocene* and *Senator Campbell* shafts and workings. Proof of continuation of deep ground up-stream in the vicinity is given by the Keystone-drilling carried out by this Department in 1919 and 1920.

After prolonged flow by way of the *Miocene* channel a second period of volcanism was initiated. The river was *again* deflected, presumably by further damming by lava, and followed, it is presumed, down-stream from Horsefly village the channel disclosed by the workings of *Ward's Horsefly* and *Hobson's Horsefly* mines.

It is important to note that both periods of volcanism left *that part of the river above Woodjam Creek* unaffected, in so far as causing any diversion of the river from its valley.

The diagnostic value of the volcanic rocks is all-important, since channels incised wholly in them cannot antedate the volcanism. Thus, such channels as are incised in volcanic ash or tuff beds and disclosed by the old workings must have been formed either during or subsequent to the earlier of the two volcanic periods. If bed-rock is not exposed, correlation must be based upon indirect evidence.

Time intervals were undoubtedly long, as evidenced by the great accumulation of residual " white channel " gravel in the *Miocene* and other channels.

The exposures of " white channel " gravel, marked Nos. 1 to 5 on the accompanying map, occur on the elevated plateau. They are apparently remnants of ancient drainage, by way of Beaver Creek Valley, that doubtless included the large tributary Moffat Creek, which possibly had no existence at the time of the first period of volcanism (in Eocene or earlier time). These exposures at widely-separated points cannot be correlated with any degree of certainty, as bed-rock is not exposed. Indirect evidence, however, suggests the possibility that the exposure at Triplet Lake is a remnant of the river drainage antedating the first period of volcanism and dammed by it. In Gravel Creek Canyon, beds of residual gravel, 2 to 5 feet in thickness, are overlain and underlain by lava of the second period of volcanism. They indicate that a flow by way of Beaver Creek Valley was dammed or interrupted by lava.

Topography.

The Horsefly River rises in rugged country, falls at an average rate of 12 feet per mile, and receives three large tributaries from the south: In down-stream order, the Mackay River (formerly named the South Fork), McKusky Creek (formerly named the Crooked River), and McKinley Creek. It should be noted that the last two are streams of approximately the same size as the Mackay River, and the term " creek " is inappropriate. The ruggedness of the country at the higher reaches of the river, likewise that of the region drained by its tributaries, decreases progressively down-stream. The wide valley in which the river meanders, between McKinley Creek and Woodjam Creek, is one of subdued relief and mature aspect. There are falls in the river just above Harvie Creek, near Sawley Creek, and about 1 mile below Club Creek. At the first point the falls are about 8 feet in height. Near Sawley Creek,

the total drop is 90 feet in a distance of about 275 yards; the fall being in four steps, the highest of which is about 15 feet. Below Club Creek in a distance of about three-quarters of a mile, there is a total drop of about 120 feet; the fall is in three steps of which the highest is about 65 feet. The length of the rocky gorge below the falls is about 500 yards.

Near these falls the topography clearly indicates that an older channel of the river lies buried instream, probably in the right bank and at great depth. McKusky Creek occupies a mature valley and enters the Horsefly a foot or so below its level, with the result that the water backs up in McKusky Creek for some distance. The valley of McKusky Creek is more mature than that of Mackay River and it is suggested that McKusky Creek at one time was the headwaters of the Horsefly River. Both McKusky Creek and the Horsefly flow on valley-fills and it is evident that originally McKusky Creek entered the Horsefly River Valley at a lower level.

Two depressions, shallow and wide, at respective elevations of about 750 and 250 feet above the river, occur in the north rim of the valley and extend east and west from Black Creek. Both trend parallel to the river for some miles. The former is clearly incised in rock; both rims are traceable for some miles. The latter is separated by knolls from the Horsefly River Valley, but these knolls may be of unconsolidated materials. These features indicate the presence of earlier river-channels the ages of which are quite indeterminate from facts now known. The higher *may* be quite old, and continuance of the present operations on Black Creek will likely yield important information concerning it in the immediate future.

A key feature of the topography is the abrupt closing-in of the wide valley, immediately below the junction with Woodjam Creek. At that point the river flows to the north of its former course, and enters what is locally known as the "canyon." In this region the river is quite shallow, only a few feet in depth, and the valley is incised in intercalated beds of volcanic tuff and lava. For a distance of about 4 miles this formation is exposed at intervals in the bed of the river, and bluffs of it up to 100 feet in height extend along the banks. South of the river there is an elevated plateau between 250 and 350 feet above the river. Below the "canyon" the valley again widens. Immediately up-stream from Horsefly the river meanders through an accumulation of glacial debris in the central part of the valley, flanked by glacial banks up to 60 feet high. When only little more than a mile from the upper end of the large Beaver Creek Valley, the river turns at right angles to its former course. Beaver Creek Valley is a master-valley trending north-westerly from this point for a distance of 40 miles to Beavermouth. Beyond, the Quesnel River Valley is continuous with it for another 20 miles. After making the turn, the Horsefly River flows almost due north into Quesnel Lake. It traverses a region of low relief, save for one discordant feature, seen immediately up-stream from *Hobson's Horsefly* mine, 5½ miles below Horsefly. There the river passes through a rock-walled gorge incised in tuff beds, the left bank rises quite sharply from the river to a height of from 125 to 175 feet. Ratdam Creek is contained in a hanging-valley, and cascades over falls 60 feet in height, which are situated at the end of a deep embayment in the river-valley 600 feet in length. The falls are incised in tightly-cemented gravel, and presumably expose the up-stream continuation of *Hobson's Horsefly* channel.

About three-quarters of a mile east of Horsefly, a depression trends north-easterly parallel to the river and finally north-westerly, emerging again in the Horsefly River Valley at the junction with the Little Horsefly River. About three-quarters of a mile east of this depression, and separated from it by a rock knoll, there is another approximately parallel depression, which at Arms Lake bends north-westerly, and to the north-west merges in the other depression. These may be Pleistocene channels of the Horsefly River.

Bed-rock Geology.

The Horsefly area in the lower reaches of the river is one of very low relief and is occupied by a number of ranches. Except for these clearings, the lower elevations are generally well covered with vegetation and timber-growth which obscure rock-outcrops. The formation is exposed mainly at higher elevations.

The formation eroded by the river and its large tributaries in its upper reaches consists of a north-westerly-striking belt of schistose rocks, chiefly sediments, including slate, argillite, and quartzite. These contain numerous quartz veins in the area drained by the large tributaries and are bordered on the west by a band of schistose greenstone. Adjoining these

rocks, down-stream between Club Creek and Woodjam Creek, the formation is seen to consist of an assemblage of flow-rocks, chiefly andesitic. They do not exhibit the same degree of metamorphism as the schists and may be of Mesozoic age. The region lies directly along the trend of the Central batholith which, however, is not continuously exposed in this region. Igneous tongues intrude the volcanic rocks at several points. The formation changes with the abrupt change in the topography at Woodjam Creek. Down-stream from Woodjam Creek for 6 miles below Horsefly the formation, where exposed, consists almost entirely of tuff or flow-rocks of Tertiary age. In subsequent paragraphs, details are given of the Tertiary formation exposed in this region. It is considered that upon the correct interpretation of the topographic change, and of the adjacent exposures of Tertiary formation, rests in large measure the solution of the complicated Tertiary drainage system of the section.

Slate and quartzite outcrop on the summit and high southern slopes of Big Slide Mountain. Schistose argillite and quartzite are exposed on the right bank of the river almost continuously between Harvie and Sawley Creeks. Slate is exposed above the mouth of McKusky Creek, and schistose greenstone below. An extensive area in this region is underlain by sediments. The contact between schistose greenstone and slate occurs just west of McKee Lake, and was followed in the course of reconnaissance for some miles to the northwest. East of the contact, sediments outcrop at several points between McKee and Crooked Lakes. The formation along the Mackay River (South Fork) area is thus described in the Annual Report, Minister of Mines, British Columbia, 1938, page 139, ". . . a well-defined belt of old sedimentary rocks, for the most part black slates and schists with occasionally argillaceous limestone. These strike in a general north 50 degrees west direction. On the western boundary of the sedimentary rocks, granite-mica gneissic rocks are found occurring interbedded as sills in the slates. A large pyroxenite dyke was noted on the eastern end of the belt of sedimentaries, near the head of Fraser Creek. Throughout the slates on all the three creeks examined in detail (Fraser, Slide, and Eureka) occur many quartz veins. These quartz veins for the most part are only a few inches to a few feet in width, averaging possibly up to 3 or 4 feet, and occasionally being as wide as 60 feet. They strike north 60 to 70 degrees west, or approximately with the bedding-planes of the slate country-rock, and dip about 30 to 50 degrees to the west. Several samples . . . were taken, but in all cases the samples upon assay returned *nil* for both gold and silver."

Auriferous quartz is known to occur in the vicinity of McKee Lake and is described on page C 32 of the Annual Report, Minister of Mines, British Columbia, 1934, under *Timber Line*. At the head of the falls on Sawley Creek, two small slightly-mineralized quartz veins 5 and 8 inches wide respectively are exposed in schistose argillite on the right bank of the river. Assays returned insignificant values.

It appears that the quartz veins are largely confined to the sediments, none are known to occur in the belt of volcanic rocks bordering the sediments on the west. However, they may be obscured by glacial debris, or if once existent, may have been entirely removed by erosion. The rocks between Club Creek and Patenaude Creek, are intruded at several points by tongues of igneous rock. At the upper end of the falls near Club Creek andesite is intruded by pyroxenite, also near this point by a small acid tongue. At the base of the falls a porphyritic granitic tongue intrudes andesite and is mineralized with slightly auriferous pyrrhotite. At 4,000 feet elevation, about a mile east of the East Fork of Black Creek, a large pyritized quartz-feldspar dyke is exposed, a sample of which assayed a trace of gold.

For a distance of about 4 miles below Woodjam Creek the river in a number of places flows over beds of white or cream-coloured Tertiary tuff. Outcrops are prominent on the banks of the river and range from a few feet to 100 feet in height. The tuff contains intercalations of lava. It is overlain by post-Glacial gravel or glacial debris; the total overlie of unconsolidated material usually ranges from 3 to 6 feet in thickness.

About 1¾ miles down-stream from Woodjam Creek intercalated lava and tuff beds are exposed on the left bank of the river. Beds of basalt exposed at river-level are overlain by tuff beds 30 feet in thickness striking north 37 degrees east, and dipping 60 degrees southeast. The latter are overlain by basalt 6 feet in thickness, which is overlain by tuff beds capped by 2 feet of gravel and soil.

About a quarter of a mile down-stream from the last exposure tuff beds are exposed on the left bank for a length of 250 feet and a height of 100 feet above the river. The lower

beds, 60 feet in thickness, are intensely folded and overlain by flat-lying beds. The latter are capped by only 1 foot of unconsolidated gravel and soil.

On the right bank of the river, opposite the mouth of Deerhorn Creek, tuff beds are exposed continuously for a length of approximately 400 feet. The bank ranges in height from 25 to 35 feet. These beds are horizontal, and are overlain by 3 to 6 feet of poorly-sorted post-Glacial gravel and glacial debris. Other smaller outcrops of tuff beds occur in this vicinity on both sides of the river.

Between Deerhorn Creek and Horsefly the formation near the river is obscured by glacial debris and vegetation.

At *Ward's Horsefly* mine, there is a small outcrop of rock identified by microscopic examination as sandstone.

On the opposite side of the river, at the point shown on the accompanying map, a dove-coloured, fine-grained diorite is exposed. This rock also forms the bed-rock at Campbell and Boswell's hydraulic pit.

In the vicinity of *Hobson's Horsefly* mine, a canyon, 300 yards in length, is incised in white-coloured tuff beds striking north-easterly and dipping 25 degrees south-easterly. Below this canyon, on both sides of the river, are outcrops, 5 to 10 feet high, of red andesite porphyry. A small island in the river at this point is composed wholly of it. Tuff beds form the eastern rim-rock at *Hobson's Horsefly* mine and apparently directly overlie the andesite porphyry. In the hydraulic pit some exposures suggest that the tuff beds and lava may be intercalated, but it is not possible to determine this point, owing to sloughing since hydraulic operations were suspended. At some points the tuff beds are undeformed and contain fossils, at others they are contorted.

About half a mile down-stream from *Hobson's Horsefly* mine, an old adit, now caved and inaccessible, is stated to have been driven several hundred feet from a point 35 feet above the river, on its left bank. Examination of the dump at the portal of the adit shows that tuff beds were encountered.

The elevated plateau lying immediately south of the Horsefly River and west of Woodjam Creek (on which occur the exposures of residual gravel marked Nos. 1 to 5 on the accompanying map) is largely covered with vegetation and glacial overburden. This obscures rock-outcrops save locally. Between Triplet and Starlike Lakes there is one small bluff of basalt. On Moffat Creek the residual gravel (exposure No. 3) underlies the lava, which is immediately overlain by glacial debris. There are two falls on this creek about 1¼ miles apart. The upper falls are incised in basalt, and the lower falls and gorge below in red andesite porphyry and breccia. On Gravel Creek beds of residual gravel (exposure No. 5), 2 to 5 feet in thickness, are both underlain and overlain by basaltic lava. China Cabin Creek, immediately below China Cabin Lake, has incised a deep gorge in red-coloured porphyritic andesite lava. A similar lava outcrops prominently on the west shore of China Cabin Lake, adjacent to exposure No. 5 of residual gravel, and immediately underlies a large part of the bench on the leases of R. N. and A. B. Campbell at the head of Beaver Creek Valley.

The creeks cascade over falls down the northern and western slopes of this plateau. The creek canyons are of post-Glacial age. No tuff beds were observed on this plateau west of Woodjam Creek.

Steeply-inclined beds of Tertiary tuff are exposed on a large knoll on the right bank of Woodjam Creek on Pre-emption Lot 9577. On a north-westerly-flowing tributary of Woodjam Creek, and on Woodjam Ridge at 3,960 feet elevation, are exposed fossiliferous tuff beds containing many plant remains and one small seam of lignite. Another lignite seam, 2 feet thick, outcrops at 4,000 feet elevation. Tuffs are exposed in the valley of this creek more or less continuously through a vertical range of 400 feet. The beds are horizontal or nearly so. At one point lava occurs in the tuff. Immediately west of this creek the summits of some of the higher-lying knolls are composed of tuff, the elevation of the highest examined being 4,470 feet, or 1,720 feet above the river at the mouth of Woodjam Creek. The south side of the river was not examined up-stream from the points mentioned. No outcrops of Tertiary lava or tuff were observed on the north side of the river up-stream from Woodjam Creek. Tertiary lava is, however, known to cap high peaks at the head of Frasergold (formerly named Fraser) Creek.

The tuff described in the foregoing paragraphs is prevailingly light-coloured, white, grey, light green, or dove-colour, occasionally it is darker. It is fissile, thinly-bedded, and composed of fine ejectamenta; occasional beds contain coarse particles up to half an inch in size. Locally it is fossiliferous and contains beds of lignite. Large pieces of petrified wood were found in the talus slope at the base of one exposure, and presumably they came from the tuff beds. Microscopic examination discloses that the tuffs are composed of semi-angular to rounded quartz grains, fragments of partly devitrified volcanic glass, and a few grains of altered feldspar. The evidence indicates that these tuffs were formed from ejectamenta deposited in relatively still water.

Fossils obtained from the tuff beds were forwarded to the Bureau of Geology and Topography, Department of Mines and Resources, Ottawa, and Dr. W. A. Bell reports as follows:—

"Lot 2929B: From Woodjam Creek; contains *Taxodium occidentale* Newberry and *Myrica diforme?* (Sternberg) Chaney.

"Lot B: From Woodjam Creek; contains *Taxodium occidentale* Newberry.

"Lot A: From *Hobson's Horsefly* Mine has *Alnus sp.* The species may be compared with *Alnus kefersteinii* (Goeppert) Berry from Chu Chua district although the leaf is considerably larger.

"Lot 2983B: From Horsefly River, 5 miles down-stream from Horsefly; contains *Taxodium dubium* (Sternberg) and a leaf of the same species of *Alnus* as present in Lot B.

"Whilst the flora is meagrely represented by these lots there is little doubt that the age is not earlier than Upper Eocene or later than Lower Miocene. I am inclined to favour an Oligocene age, although Berry could doubtless consider the age as Upper Eocene or at most not later than lower Oligocene. I would say also that the beds of Woodjam Creek are about the same age as those from Horsefly River."

A fossil fish was also sent in for determination but was considered too fragmentary for positive identification. However, Cope has described two species—namely, *Amyzon brevipinni* and *A. commune*—from the Horsefly River and this fish is possibly one or the other.

It is apparent that up-stream from Woodjam Creek the terrain eroded by this river in Tertiary time was capable of supplying gold for the formation of deposits of placer on bed-rock. It is also a fact of interest that channels incised in tuff, such as *Hobson's Horsefly* mine, wherein no resorting is evident, contain bed-rock values, indicating the distant up-stream source of the gold. The quartz vein terrain was doubtless the source of the residual quartz pebbles contained in the several large exposures of "white channel" gravel.

Glacial Geology.

The mantle of glacial debris now remaining in the valley at elevations only a few hundred feet above the river does not appear to be thick. Round-topped knolls at elevations as high as 4,500 feet were found to be covered with only a few glacial erratics. The evidence suggests that the accumulation of ice during the Pleistocene period must have been very thick, and that it probably covered the very rugged high terrain at the headwaters of the river and its tributaries. Enormous volumes of water must have flowed down the valley during retreats of ice. Evidently in the final retreat of ice the river succeeded in clearing its valley to a large extent of glacial debris, which is now apparently thickest in the immediate vicinity of Horsefly.

In consequence of the removal of glacial debris, finally effected by post-Glacial water, there is now revealed in the valley for some miles above Woodjam Creek a picture similar to that which must have existed at the time of the lacustrine conditions in the Tertiary. In this part of the very wide valley there are, even now, several small lakes, and it can readily be understood that a dam at any point would cause the formation of extensive sheets of water within the valley.

Glacial striæ were found west of Black Creek, at an elevation of 650 feet above the river. They indicate a westward movement of ice within the valley.

Tertiary-drainage History.

The Tertiary rocks of this area are of fundamental importance. Upon them hinges the correct interpretation of the Tertiary-drainage history. A review is therefore given of

information published by the Geological Survey, Canada, concerning the two periods of volcanism, separated by one of sedimentation, exemplified more especially in the Fraser River Valley. It is considered that similar periods are found in the Horsefly River Valley.

In the Fraser River Valley the two periods of volcanism are represented by the Lower Lavas and the Upper Volcanics, and the intervening period of sedimentation by the Fraser River formation.

The Lower Lavas were assigned by Dawson to the Miocene, and were divided by him " into two portions separated by a period of sedimentation during which certain fine-grained tuffaceous beds were deposited." These Lower Lavas, with details of a section with intercalated tuffs including white volcanic ash, are described by Reinecke on pages 11 and 12 of Memoir 118, Geological Survey, Canada, 1920. Reinecke also described the Upper Volcanics on pages 17 and 18, and the intervening Fraser River formation on pages 13–17 of the same publication.

Cockfield has, however, shown that the age of the Fraser River formation is late Eocene, and that of the Lower Lavas, Eocene or earlier (Summary Report, 1931, Part A 1, Geological Survey, Canada, page 59), and also confirms Reinecke in assigning the Upper Volcanics to the Miocene (Summary Report, 1932, Part A 1, Geological Survey, Canada, page 85).

The Upper Volcanics consist mainly of fresh-looking, flat-lying, or gently-inclined olivine basalt that is black in colour. They occur either in topographically high positions, capping valley-rims, as for example in the Fraser River Valley and on Moffat and Gravel Creeks; or as valley-fill, for example in the lower part of the Beaver Creek Valley, described by Cockfield and Walker in Geological Survey, Canada, Summary Report, 1932, Part A 1, page 84. No white tuff has been found in the Upper Volcanics.

The Lower Lavas, considered in the aggregate, are less basic and are more disturbed than the Upper Volcanics. They also evince a greater degree of metamorphism. It is considered that the assemblage of purple or reddish-coloured volcanic rocks exposed at the lower falls on Moffat Creek and in the gorge below these falls, at China Cabin Creek Gorge, on the leases of A. B. and R. N. Campbell, at the upper end of Beaver Creek Valley, in and adjacent to the Horsefly River at *Hobson's Horsefly* mine, and in the hydraulic pits at this property can be correlated with the Lower Lavas. At the last point some of the lava appears to be intercalated with tuff beds, but owing to the highly-disintegrated condition of the exposures it cannot be exactly determined. Some of the above-mentioned exposures are much altered andesite, some are tuffaceous, some porphyritic with phenocrysts of plagioclase feldspar, and some are breccias. A large amount of reddish-brown hematite is present in all, and at some points they contain native copper. The intercalated lava-flows in tuff beds belong to the Lower Lavas.

The sharp distinction between the eruption of the Lower Lavas and sedimentation may not be found in the Horsefly area to the same extent as it is in the Fraser River Valley, but the evidence is strong that the river was involved in both periods of volcanism. No exposures of the Upper Volcanics were observed capping tuff beds. In the Horsefly area exposures indicate that eruption of the Lower Lavas at first alternated with tuff deposition. Later, there was a long period of tuff deposition when lava eruption practically ceased. The whole period, represented in this area by eruption of the Lower Lavas and deposition of all tuff beds, is thought to correspond with the Lower Lavas and the Fraser River formation in the Fraser River Valley. The topographic and geographic position of exposures is significant. For example: The low topographic position of the Lower Lavas at the head of Beaver Creek Valley indicates that they blocked the valley; the Upper Volcanics on Gravel Creek, with intercalated exposures of residual gravel, indicates blocking of this valley at a *down-stream* point at a later period.

From the foregoing it is evident that exposures of *bed-rock* are fundamental to determination of the *age* of the channel system. Thus, the *bed-rock* of a channel interrupted by the first period of volcanism must have been incised in formation older than the Lower Lavas. In the absence of exposure of *bed-rock*, age-determination can only rest on indirect evidence, taken in conjunction with the nature of the contained gravel.

In this connection reference is invited to the description given in this volume of a river-channel, under " Property of R. Blair." The exposure is of a river-channel incised in rocks of Carboniferous age. The gravel contains lava beds correlated with the Lower Lavas. The suggestion is that the river was dammed by lava at the time of eruption of the Lower Lavas.

History.

All important history centres on the three old properties, the *Miocene, Ward's Horsefly,* and *Hobson's Horsefly* mine, as they have for the sake of brevity long been termed. Their full names are, respectively, the Miocene Gravel Mining Company of Cariboo, Limited; Horsefly Gold Mining Company, Limited; and Horsefly Hydraulic Mining Company, Limited. At all these properties operations were terminated between the years 1899 and 1902, and subsequently no major activity has developed in the area.

A small amount of Keystone-drilling was done about 1902 on Moffat Creek by R. T. Ward, and in 1911 in the area contiguous to *Ward's Horsefly* mine by an eastern syndicate. At the latter property a short-lived renewal of activity by the International Dredging and Exploration Company took place in 1918, in which year B. R. MacKay, of the Geological Survey of Canada, made an examination of the area, an account of which is given in Summary Report, 1918, Part B, Geological Survey, Canada, pages 54 and 55. In 1919 and 1920 a campaign of Keystone-drilling, in the vicinity of *Ward's Horsefly* mine, was carried out by this Department, full information of which is given in the Annual Reports, Minister of Mines, British Columbia, 1919 and 1920. This disclosed rich ground only in one hole, but hole No. 1 located the up-stream continuation of the *Miocene* channel.

In subsequent years activity was largely confined to individuals, chiefly R. N. Campbell, G. Kuchan, A. N. Walker, and others, whose efforts have afforded valuable information at several different points. In 1930, following some preliminary shaft sinking, G. Kuchan, J. Mikklesen, and associates carried out some deep Keystone-drilling at the exposure of residual gravel at Triplet Lake. This work is stated to have found encouraging gold values extending to considerable depth. In 1934 R. W. Tarp installed a suction-dredge on the river below *Hobson's Horsefly* mine and subsequently a drag-line at the same point. These operations, however, were not of long duration.

This year, interest in the area was revived by the operations of Sig Johnson and associates on Black Creek (subsequently described in detail), which disclosed important facts bearing on dredging possibilities.

Detailed accounts of the early operations at the *Miocene, Ward's Horsefly,* and *Hobson's Horsefly* mines will be found in the Annual Reports, Minister of Mines, British Columbia, for 1902, 1918, and 1920. It is unfortunate, however, that certain important information concerning these properties is lacking and cannot now be obtained owing to inaccessibility of workings. In only one case, apparently, has a map of the workings been preserved. Comment herein given concerning these properties is based upon particulars of workings given in the reports cited, together with such other information as could be secured from first-hand observation. Details considered to be unimportant are omitted.

Miocene Mine.

It is important to note that the workings of this property consist of *two* deep shafts, not one, as is generally supposed. These are known as the *Miocene* and the *Senator Campbell* shafts. (The latter, named after the late Senator R. H. Campbell, manager of the company concerned, should not be confused with other shafts marked *Campbell* shafts on maps of *Ward's Horsefly* mine in early reports.) Both these shafts are situated in the village of Horsefly, the former at the western end and the latter 1,500 feet to the north-west. They are at approximately the same elevation, as shown on the accompanying map, and are on an extensive bench on the left bank and about 25 feet above the Horsefly River.

Both shafts explore the deep *Miocene* channel, whose eastward continuation up-stream is plainly indicated by Keystone-drill hole No. 1 put down by this Department in 1919. The westward or down-stream continuation of the channel is not known from direct evidence, but is inferred, from evidence cited later in this report, as having been by way of Beaver Creek Valley.

The *Senator Campbell* shaft was sunk in 1897, and in the Annual Report, Minister of Mines, British Columbia, 1902, is thus described: " The shaft was sunk vertically for about 275 feet, when it struck bed-rock, which was found to be still pitching deeper. This shaft was continued 50 feet deeper into bed-rock, at which point, 325 feet below the surface, a drift 150 feet long was set off to and into the gravel, but the bed-rock was still found dipping to the west. From the bottom of the shaft an incline, 200 feet long and gaining 125 feet in depth, was put down in the country-rock, and another drift was run to the gravel, which was

found in a distance of 60 feet, but with bed-rock still dipping away at an angle of 30 degrees. At this point, 450 feet from the surface, very fair prospects are said to have been obtained from the gravel, but no further work was done here, and the shaft was abandoned."

The *Miocene* shaft was sunk vertically in 1899 to a depth of 490 feet, bottoming on rim-rock sloping at 15 degrees. It was deepened in rim-rock to a total depth of 555 feet, at which point a crosscut, 500 feet long, was driven in the direction of and under the channel. From this crosscut raises 20 and 15 feet high reached the channel at points 400 feet and 500 feet respectively from the shaft. When the second raise holed through to the channel, "there was a rush of water and gravel, which drove the men out, but they managed to bulkhead the crosscut."

Unfortunately this operation was abandoned immediately after this untoward occurrence, when slight additional expense possibly would have given access to bed-rock, on which the chief concentration of gold values was logically to be expected. "In sinking this shaft the gravel was found to be capped with about 100 feet of blue clay, and nearly 400 feet of gravel was passed through containing gold but not in paying quantities. The gravel is free and very uniform in size, being composed almost entirely of smooth, worn, white quartz pebbles. As seen on the dump, the gravel from this shaft is particularly noticeable, first for its light colour, occasioned by the absence from the quartz of all pebbles of slate or basaltic rock, and secondly for its remarkably uniform size, while the individual pebbles are rounded and not flattened. In all these points it varies materially from the wash as seen at Ward's Horsefly hydraulic or at Hobson's Horsefly." (Annual Report, Minister of Mines, British Columbia, 1902.)

Unfortunately no maps of these shafts are available, and reports do not state the bearings of the various underground workings. This information would have thrown additional light on the direction of the channel and of the character of the bed-rock. At the time of the present examination, samples were obtained by digging in the dumps at the collars of both shafts. Microscopic examination of these revealed that the formation encountered in the workings from both shafts were undoubtedly either volcanic ash or tuff. As these dumps have been exposed to the weather for forty years, it was not possible to differentiate between the two rocks.

The down-stream course of the *Miocene* channel is indicated as having been by way of the Beaver Creek Valley, because the exposures in Gravel Creek Canyon demonstrate that a stream-flow was dammed at that point by lava of the *second* period of volcanism. Although the exposure cannot be positively identified as that of this channel, and might be that of its tributary Moffat Creek, the view is supported that a flow by way of Beaver Creek Valley, following the first period of volcanism, was finally arrested and diverted by the second period of volcanism. Presumably it was the second volcanic eruption that locally diverted the river from its former path.

There is insufficient evidence to determine if upon abandonment of the *Miocene* channel, the river flowed by way of Ratdam Lake before following the *Ward's Horsefly-Hobson's Horsefly* channel. There is residual gravel on the north shore of Ratdam Lake that may indicate such was the case. This point can only be determined by additional field-work.

Up-stream from the *Senator Campbell* shaft, the Department's Keystone-drill hole No. 1, topographic features, together with consideration of the conditions then obtaining, indicate that the course of the channel approximately coincided with the edges of the plateau that lies west of the river down-stream from Woodjam Creek. Down-stream from Woodjam Creek, therefore, the channel presumably lies deeply buried, somewhat north-east of the present river, although approximately parallel with it. Up-stream from Woodjam Creek the channel must lie within the present valley.

There seems no reason why gold should not be found in the bed-rock gravel of this channel. However, it should be borne in mind that creeks, not rivers, are the agencies whereby bonanza concentrations of placer gold are laid down on bed-rock. Nevertheless, it is known that there are gold values in the bed-rock gravel in *Hobson's Horsefly* mine. In the *Miocene* channel better bed-rock values than the latter might justifiably be expected, as the gravel represents more prolonged erosion of the same terrain. Access cannot now be gained to any workings of this mine, consequently particulars given here are taken from the Annual Report, Minister of Mines, British Columbia, 1902.

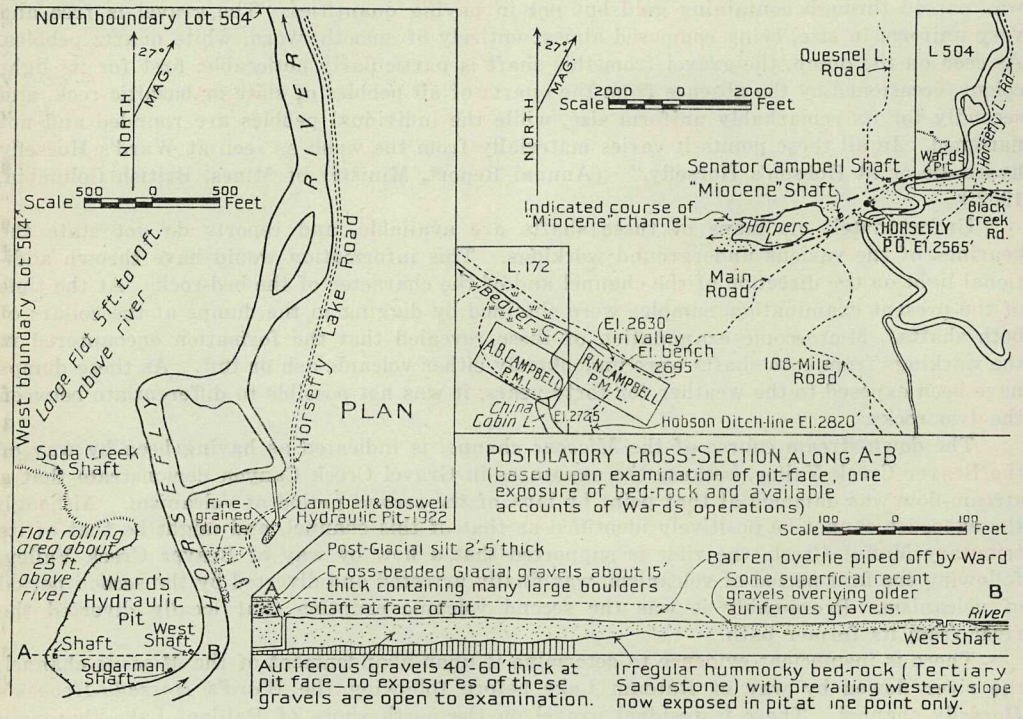
Ward's Horsefly Mine.

This operation is on Pre-emption Lot 504, a ranch owned by A. F. Dogherty, on the left bank of the Horsefly River, immediately down-stream from the village of Horsefly. Placer-mining Leases Nos. 2884 and 2923, standing in the names of A. Carfrae and C. R. Carfrae, of Horsefly, now cover the site of the earlier hydraulic operations.

The property is readily accessible and is reached from Horsefly by a motor-road a few hundred yards in length.

The region embraces a low-lying area of considerable extent on the left bank of the river. In this section the river has been deflected considerably east of its original course by deposition of tailings.

The river is flanked by an extensive bench only 5 to 10 feet above it and a smaller one about 25 feet above. The area is covered partly with grass, partly with brush, and partly with a few stands of light timber. *Ward's Horsefly* hydraulic pit is at the up-stream end of this ground.



Ward's Horsefly Mine and neighbouring properties.

Much information concerning the exact nature of the material encountered and removed by Ward's operations is now lacking, and accounts are somewhat conflicting in certain important details. Consequently the views expressed herein are subject to limitations, although in part they are supported by first-hand observation.

The placer occurrence is apparently part of a largely buried river-channel incised in sandstone. The sandstone, although irregular to some extent, dips westward and away from the river at an angle ranging from 10 to 30 degrees. The upper part of this buried deposit has been resorted and enriched due either to passage of inter-Glacial waters over it or to the fact that the channel crossed the *Miocene* channel. It is inferred that originally the exposures gave a cross-sectional view of part of a buried channel of great indicated width. The channel trended northward, and only part of the eastern rim with its overlying gravels was revealed. Similarity of the cross-section of such channel to that exposed at *Hobson's Horsefly* mine, 5 miles down-stream, is evident.

Originally, rich bed-rock gravel was, according to reports, discovered in the bed of the river at "Harper's Bar," the barren glacial material having been entirely removed by the

river. The prevailing westerly slope of the rim-rock, and an increasing thickness of barren overlie, defeated first the efforts of the earliest miners, and later those of R. T. Ward, to follow the pay-gravel for more than a short distance instream and westerly. It is to be noted, however, that all early and late investigation was directed on the assumption that the rich gravel encountered in this region originated from an earlier and resorted westerly-flowing channel. No investigation, save the *Soda Creek* shaft (mentioned subsequently), was directed towards ascertaining if this gravel continued northward.

Ward's operations consisted of hydraulicking, followed by elevation of gravel by hydraulic elevator to the sluice-flume. These operations are stated to have resulted in the recovery of gold to the value of $500,000. In 1911 an Eastern syndicate Keystone-drilled the area contiguous to this ground. This was followed by the installation of a drag-line by the International Dredging and Exploration Company in 1916. The operation apparently involved the reworking of tailings from the previous work. Keystone-drilling was undertaken by the Department in 1919 and 1920, a full account of which will be found in the Annual Report, Minister of Mines, British Columbia, 1920. This disclosed important values in only one hole, No. 4c, at the edge of the river on the left bank. Attracted by the values in hole 4c, different individual operators made two unsuccessful attempts to sink shafts in its immediate vicinity. These shafts are known as the "West" and "Sugarman" shafts. In 1936, interest in the region was revived by the fact that A. N. Walker and associates, under agreement with the leaseholders, unwatered the old *Soda Creek* shaft on Placer-mining Lease No. 2923. It is stated that in the sixties this shaft was sunk to a depth of 75 feet. A. N. Walker reports that on reopening the shaft values of several dollars per cubic yard were encountered at some points. Operations were discontinued, after a considerable amount of drifting was done, because of the expense of working under adverse conditions. Unfortunately this shaft was under water and could not be examined.

The face of Ward's hydraulic pit indicates that a thickness of from 15 to 20 feet of barren overburden must have been piped off before pay-gravel could be elevated to the sluice. It is further evident that immediately down-stream from Ward's hydraulic pit this overburden has been largely removed by post-Glacial water. The collar of the *Soda Creek* shaft is at the southern extremity of the low-lying part of the area.

An examination of the face of Ward's hydraulic pit shows, at the top, a thickness of from 2 to 5 feet of silt; underlying this is about 15 feet of cross-bedded gravel containing numerous large boulders; and below is now visible only the top of the resorted auriferous gravel, known locally as "blue gravel." The "blue gravel" was mined by Ward and the early miners. It rests on bed-rock and it is stated gradually increases in thickness away from the river until it reaches a maximum of 40 to 60 feet at the pit-face. Microscopic examination of a specimen from the one exposure of bed-rock now remaining in the pit shows it to be a fine-grained, iron-stained sandstone composed predominantly of semi-angular to rounded quartz grains. The bedding could not be seen in the small exposure.

The uppermost layer of silt exposed at the face of Ward's pit is undoubtedly of post-Glacial age, and the underlying cross-bedded gravel with large boulders is Glacial. The underlying resorted gravel, the auriferous "blue gravel," is considered possibly to be of inter-Glacial age. The post-Glacial silt betokens sluggish movement of the waters at the time. When the down-stream obstruction was removed, rapid cutting resulted in the more or less complete removal of the underlying glacial materials down to the top of the inter-Glacial gravel; e.g., down-stream, near the *Soda Creek* shaft.

Available accounts, although somewhat conflicting, indicate that the auriferous gravel was richest in its upper part, and that this was more pronounced at instream points, although values were also encountered immediately overlying the bed-rock. This may indicate resorting of the upper gravel of this channel by inter-Glacial water, or enrichment may be due to the intersection of the *Miocene* channel.

It is notable that the lowest point of the gently-sloping bed-rock of this channel is far *below* river-level, and that the centre of the channel must be lower still, whereas it is probable that the bed-rock of *Hobson's Horsefly* is above river-level. Early accounts of Ward's operations emphasize the similarity between its gravel and those of *Hobson's Horsefly* mine. The bed-rock at *Hobson's Horsefly* mine is higher than at *Ward's Horsefly* and this would suggest a southward flow; however, the evidence available indicates that the flow of the

drainage system was northward. Therefore the higher bed-rock at *Hobson's Horsefly* mine suggests it is a different channel or that, if the same, warping or faulting has elevated it.

Ratdam Creek cascades over falls in the cemented gravel of *Hobson's Horsefly* channel 60 feet in height, indicating rejuvenation of the drainage system *after* deposition of gravel. The rich gravel of *Ward's Horsefly* mine presumably resulted from a resorting of upper gravel strata of this channel in one or other of the two ways mentioned; *Hobson's Horsefly* channel was not so affected.

It seems reasonable to assume that gold values in the *Miocene* channel would be mainly confined to gravel immediately overlying bed-rock, and therefore below the reach of the resorting influence of the water of *Ward's Horsefly* channel. If such were the case, resorting must be attributed to inter-Glacial water.

It is desired to emphasize the fact that opinions expressed concerning *Ward's Horsefly* mine, and its possible relationship to *Hobson's Horsefly* mine, can only be regarded as tentative, because important criteria have now been entirely obliterated. For example, it is not *now* evident, from exposures, that the picture originally presented at *Ward's Horsefly* mine was that of part of a large channel resting on bed-rock sloping gently west (away from the river), although it is not, of course, suggested that such was not originally evident. On the other hand, it is now evident from exposures in Campbell and Boswell's hydraulic pit that on the right bank of the river, almost directly opposite, part of a large channel with bed-rock sloping gently eastward is exposed. The possible relationship of this to the *Hobson's Horsefly* channel is a matter for consideration and is discussed in the paragraphs immediately following.

Operations of R. N. Campbell and W. J. Boswell.—In connection with the foregoing discussion regarding *Ward's Horsefly* mine, the results obtained on the opposite side of the river by R. N. Campbell and W. J. Boswell are informative.

Following Keystone-drilling by this Department in 1920, that indicated comparatively shallow ground immediately north of the deep *Miocene* channel, R. N. Campbell and W. J. Boswell, deriving a water-supply from a small lake, opened up a hydraulic pit on the right bank of the river and about 385 feet distant from it. The pit is about 35 feet above river-level and is shown on the accompanying map. The pit exposes 6 feet of mainly glacial material, overlain by 2 feet of river-silt, and underlain by 2 feet of coarser semi-residual gravel which rests on bed-rock. The bed-rock gravel in part presumably originated from the *Miocene* channel.

The rock is water-worn and slopes at a gentle angle away from the river towards a high bank of glacial gravel flanking the river. This slope of the rim defeated the efforts of Campbell and Boswell to follow the pay-gravel eastward and instream. It is reported that fair values were encountered. The rim-rock at this point is fine-grained diorite. Precisely similar rock outcrops at several points, in a distance of about 300 feet, on the right bank of the river, south-west of the hydraulic pit.

Near by, to the north and south of this point, are older workings, adits, and shafts, now caved, that indicate early miners did considerable prospecting in this region.

Exposures are of a cross-section of part of a large channel whose bed-rock slopes gently eastward away from the river. The significance of this channel is a matter of interest. The gravel resting on bed-rock is overlain by glacial materials and must, therefore, be of inter-Glacial or pre-Glacial age. There is no evidence, in the form of a secondary placer deposit, between Campbell and Boswell's workings and *Hobson's Horsefly* mine to indicate that the up-stream continuation of *Hobson's Horsefly* channel is cut by the Horsefly River. Apart from this, there is nothing known to the writer incompatible with the suggestion that the Campbell and Boswell channel *might*, like *Ward's Horsefly* channel, be the up-stream continuation of the *Hobson's Horsefly* channel.

The bed-rock of the Campbell and Boswell channel presumably slopes instream under the high knoll about three-quarters of a mile wide at its base that separates the river from the more westerly of the two well-defined depressions trending more or less parallel to the river, and previously mentioned in paragraphs relating to topography. These two depressions are separated by a rock knoll near Arms Lake. Whether the more westerly of these has any relationship to the Campbell and Boswell channel is a matter of conjecture.

In the historical summary given on page 32 of "Placer-Mining in British Columbia," Bulletin No. 2, 1930, it is recorded that in 1859 the early miners found "Horsefly Creek (now named Little Horsefly River) leading to Horsefly Lake, and discovered on this creek the richest placers found up to that time in the basin of the Quesnel." No remaining evidence of this discovery is known to the writer, but it appears that the Little Horsefly River cut through an old channel.

In the absence, however, of any definite evidence that the Horsefly River itself cut the up-stream continuation of the *Hobson's Horsefly* channel between *Hobson's Horsefly* mine and *Ward's Horsefly* mine, it seems more likely that the channels exposed at these two properties are parts of the same channel than that the Campbell and Boswell channel is related to the *Hobson's Horsefly*. At the same time, the latter possibility can not be overlooked, although the supporting evidence now obtainable is meagre. It is to be noted, however, that this alternative correlation does not affect the main outline of the drainage history of the Horsefly River.

Hobson's Horsefly Mine.

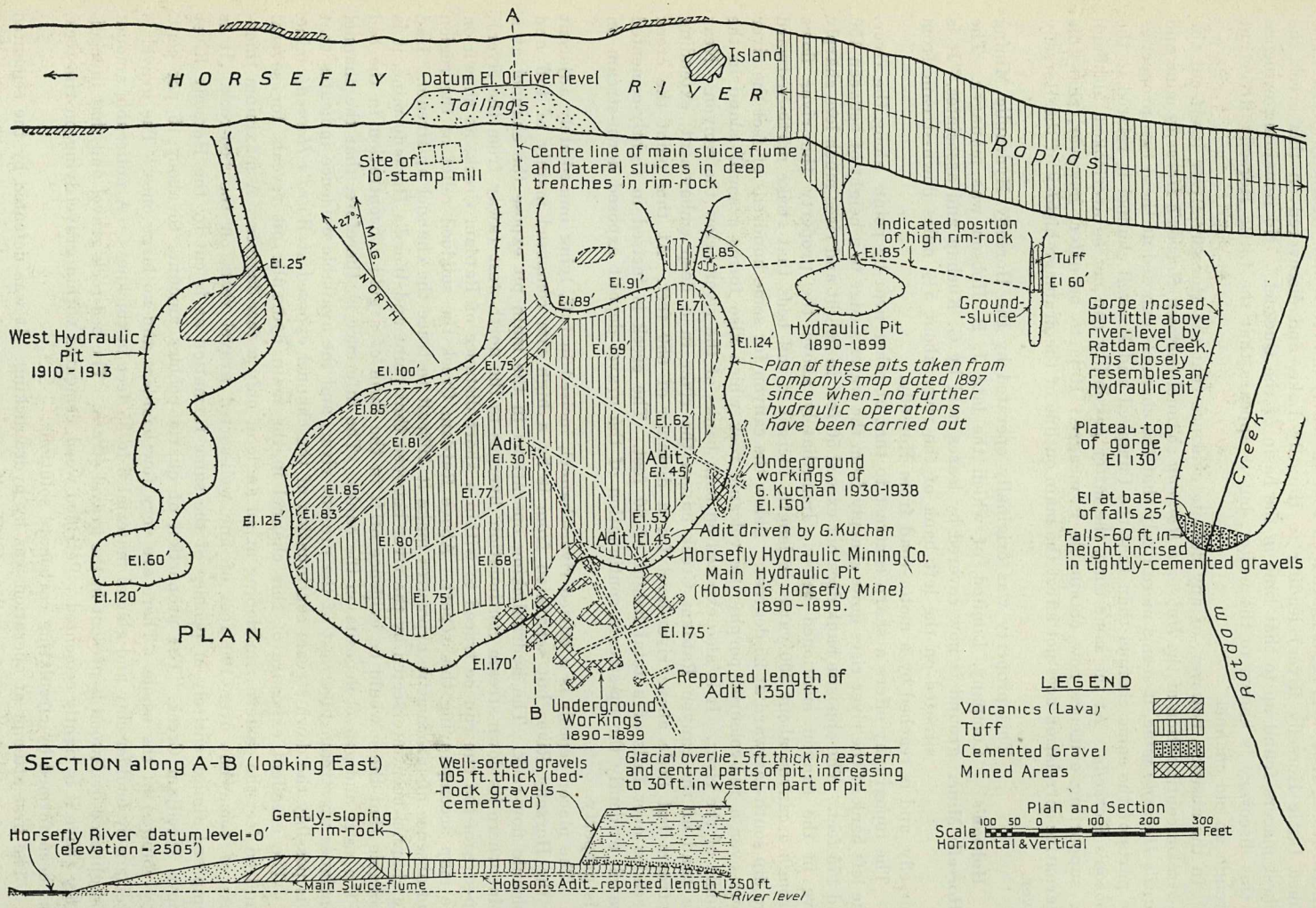
This property was originally operated by the Horsefly Hydraulic Mining Company, Limited, of which the late J. B. Hobson was manager. The ground is now covered by leases held by G. Kuchan and associates. It is situated on the left bank of the river about 5½ miles down-stream from Horsefly, and is reached by a motor-road from Horsefly.

The topography offers a sharp contrast to that at other near-by points along the river. The left bank of the river rises quite sharply from the water's edge to a height of between 150 and 175 feet. The opposite bank does not exceed 50 feet in height and rises much less sharply save in the canyon mentioned below. Immediately above the property the river flows through a canyon about 300 yards in length, incised in tuff beds that strike north-eastward and dip south-eastward at 25 degrees. Below the canyon for some hundreds of feet the river flows over a red-coloured porphyritic volcanic rock which also forms a small island in the middle of the river. It is also exposed on both banks of the river below the canyon. Near the head of the canyon Ratdam Creek enters the river in a deep embayment, extending instream but little above river-level for a distance of 650 feet. At this point the creek cascades over falls of a total height of 60 feet. The creek is incised in tightly-cemented gravel, evidently the up-stream continuation of the gravel deposit exposed down-stream on this property.

The placer deposit is a buried river-channel, incised in tuff, lying immediately adjacent to the Horsefly River but separated from it by a high rim composed mainly of tuff and volcanic flow-rock. The hydraulicking operations in the main pit expose the channel at a point where its down-stream continuation diverges to the north-west (away from the river). Up-stream the rim can be traced to within a short distance of Ratdam Creek, as shown on the map accompanying this report. Above Ratdam Creek the subdued relief of the region and absence of informative exposures make it difficult to trace the channel up-stream. Had the channel been intersected by the river between that point and *Ward's Horsefly* mine, it is probable that there would be evidence of it in the form of a gold concentration in the bed of the river and gravel deposits on the banks. The inference is, therefore, that the channel continues up-stream just west of the present river, and the available evidence indicates that it is possibly the down-stream continuation of the channel exposed at *Ward's Horsefly* mine.

The excellent exposure of this channel in the main hydraulic pit reveals for several hundred feet the eastern rim sloping at an angle of only a few degrees. A maximum thickness of somewhat over 100 feet of fine well-sorted gravel rests on the bed-rock. It is composed almost entirely of pebbles of the same formation as is cut by the Horsefly River above Woodjam Creek. The proportion of quartz pebbles amounts to about 15 per cent. (by volume) of the whole. There are very few boulders and no large ones. The gravel is overlain by boulder-clay and glacial material 5 to 35 feet in thickness. A noticeable amount of lignitized driftwood is present in the gravel strata. The bed-rock gravel and that immediately above it is tightly cemented. Petrified wood, cemented within gravel lying on rim-rock, has been formed by circulating carbonate solutions.

The first attempt at operation was by hydraulicking. It was defeated by the cemented gravel and lack of dump for tailings. Finally, the cemented gravel was drifted and milled in a stamp-mill. An adit was run from the hydraulic pit, at a point 30 feet above the river,



Hobson's Horsefly Mine (now owned by G. Kuchan).

for a total distance of 1,350 feet. Early accounts of this property state that at 550 feet from the portal, " The surface of the bed-rock was down to the track-level of the tunnel, but it soon rose again." It therefore appears likely that the bed-rock of the channel at this point is possibly somewhat above, and certainly not far below, the level of the river. The cross-sectional dimensions of the channel are such that very slow cutting is indicated, further shown by the nature of the gravel, which may be termed " semi-residual." These features, differing fundamentally from those of Pleistocene channels, suggest that it is of pre-Glacial age.

As previously mentioned, the evidence in this vicinity indicates that a block was uplifted and tilted south-east as demonstrated by the attitude of the tuff. In the Annual Report, Minister of Mines, British Columbia, 1897, it is reported that the gravel shows evidence of disturbance subsequent to its deposition. This is no longer apparent. For these reasons it is considered a Tertiary channel, but younger than the *Miocene* channel, and that its up-stream continuation is possibly the channel exposed at *Ward's Horsefly* mine. The difference in bed-rock levels at the two properties is attributed either to faulting or warping. Down-stream from *Hobson's Horsefly* mine, although the course of the channel is purely conjectural, it seems most likely that it continued north-westward before finally rejoining Beaver Creek Valley.

Up-stream from *Ward's Horsefly* mine the course of this channel, although supported by indirect evidence only, probably coincided with that of the *Miocene* channel, but at a higher level.

The gold values in the gravel are largely confined to the few feet immediately overlying bed-rock; they also occur in the bed-rock itself. The values are clearly shown by the particulars given in the Annual Report, Minister of Mines, British Columbia, 1902, in which it is stated that " in the progress of opening up the mine as a drifting proposition, some 9,900 tons of gravel, soft bed-rock, etc., mined in the various drifts were put through the stamp-mill and produced $14,564.21, or about $1.46 per ton." It will be noted that the value is the *recovered* value, the price of gold then was $20.67 per ounce.

The present owner of this ground, since acquisition some years ago, has mined a considerable yardage of rim-rock gravel immediately adjacent to the face of the hydraulic pit. These workings are shown on the accompanying map. He states that values in the area mined are about $3 per cubic yard, at the present price of gold.

That this channel bends north-westward near the main hydraulic pit is proved not only by appearances at the north end of the pit, but also by another hydraulic pit, the *West* pit, opened up from the river immediately down-stream, by E. J. West and associates in the years 1909 to 1913. Although there has been much sloughing in this pit it exposes gravel of a totally different character, resting on reddish andesitic rim-rock. This gravel is overlain by much glacial material, and therefore presumably was deposited by an inter-Glacial stream. Remnants of similar gravel are to be found on small rock-benches at points up-stream. The benches are cut in the rim-rock, dividing the *Hobson's Horsefly* channel from that of the present river.

" The total amount of material mined by E. J. West is said to have been 390,000 cubic yards, of which 40,000 cubic yards was gravel which yielded 25 cents to the yard, the remainder being clay, etc., which ran less than 2 cents to the yard." (Annual Report, Minister of Mines, British Columbia, 1913, page 62.)

Many years ago the belief existed that what may be termed the continuation of the " West Channel," described above, lay buried instream and west of the river at down-stream points. An adit, known as the " Thompson tunnel," was driven about 35 feet above the river at a point about half a mile down-stream. This adit, which has now caved, is stated to have been driven for a considerable distance and then abandoned. Examination of the dump at the portal reveals that tuff beds were encountered.

Opposite, and for a considerable distance down-stream from *Hobson's Horsefly* mine, G. Kuchan reports that good gold values are found in the bed of the river. It is reasonable to assume, in the first place, that such would be the case, as the river almost certainly cut across gravel lying on high parts of the east rim of *Hobson's Horsefly* channel, and effected a reconcentration of gravel contained in the inter-Glacial " West Channel." Furthermore, there has undoubtedly been a considerable deposition of fine gold resulting from disintegra-

tion of cemented gravel, the tailings from the hydraulic operations at *Hobson's Horsefly* mine. Whenever the stage of water permits, the owner of this ground reports satisfactory results by shovelling the gravel, within reach at the edge of the river, into a sluice-flume supplied with water from a near-by source.

In this region of reconcentration, although there are glacial banks on the right bank, the left bank is low and the valley wide, so that opportunities for wing-damming are good. Some drilling done at this point two years ago is reported to have yielded encouraging results, and the region merits investigation.

In this part of the river, R. W. Tarp installed a suction-dredge in 1934, and subsequently a drag-line, but these operations were only of short duration.

Leases of R. N. and A. B. Campbell.

Two placer-mining leases at the extreme head of Beaver Creek Valley, owned by R. N. and A. B. Campbell, of Horsefly, are under option to A. N. Walker and associates, of Horsefly. The property is on the south slope of Beaver Creek Valley, immediately east of China Cabin Creek, which flows from China Cabin Lake, elevation 2,725 feet, into Beaver Creek Valley. (" China Cabin " is an old cabin, now an historic landmark, situated at the junction of the Beaver Valley road with the main road.) The main road from Williams Lake to Horsefly passes through the property, which is distant about 1¾ miles from Horsefly. A short branch road, about 300 yards in length, leads from the main road to the workings on the south side of the valley.

The chief topographic feature is a bench at an elevation of 2,695 feet, between 300 and 400 feet in width, narrowing at one point to about 70 feet, and about 2,000 feet in length. It lies about 65 feet above the floor of the Beaver Creek Valley and trends in a general direction north 73 degrees west, approximately parallel to the valley and on its south side. The bench is lightly-timbered and slopes down to the valley at an angle of about 14 degrees. The ground rises rather more sharply at the back of the bench to the plateau-level about 125 feet above it (elevation 2,820 feet), on which the old Hobson ditch-line is situated. This ditch-line was constructed over forty years ago to carry water from Moffat Creek to *Hobson's Horsefly* mine.

The bench is mainly covered with vegetation, but the formation is exposed at several points: above the bench on Hobson's ditch-line; on the slope at the back of the bench in the central and south-eastern parts; at the eastern and central part of the bench; on the slopes below the bench; and is well exposed in the gorge incised by China Cabin Creek immediately below China Cabin Lake. Exposures are of reddish-coloured andesitic porphyry and breccia.

The placer deposit is a post-Glacial concentration in gravel overlying boulder-clay, save at some points, where it immediately overlies the volcanics.

After discovering the ground in 1936 R. N. Campbell, the discoverer, and his associates carried out a large amount of preliminary testing by ground-sluicing. A supply of water for this purpose was conveyed from China Cabin Lake by a flume and ditch-line built along the slope about 20 feet above the bench.

In 1937 these leases were optioned by O. T. McShane, who devoted the entire season to testing the gravel systematically by sinking about thirty-five shafts and separately washing the entire yardage from each shaft. The object was to ascertain the average values down to the boulder-clay or bed-rock. All shafts were stopped after boulder-clay was reached. The greatest depth of any shaft was 18.5 feet, most were considerably less. The shafts were sunk at about 100-foot intervals on cross-sectional lines from 300 to 350 feet apart.

This year an option was secured by local interests—A. N. Walker and associates—who took advantage of the old Hobson ditch-line, a happy feature of this property, inasmuch as Moffat Creek affords a large supply of water. The ditch-line was repaired, hydraulic plant installed, and operations commenced. By the end of September upwards of 5,000 cubic yards had been hydraulicked from a pit in the central part of the leases.

The auriferous material overlying the boulder-clay or bed-rock consists of poorly-sorted fine and coarse gravel containing quartz pebbles and boulders. The minimum depth of the overlying auriferous material is about 2 or 3 feet. The maximum depth is not known, but the shafts proved a thickness exceeding 18 feet in the western part of the ground. Average values are not known to the writer, but it is stated that from 162 cubic yards of gravel taken from one of the preliminary pits 6 oz. of gold was recovered. The gold, although fine, is stated to be easily recovered in a sluice-flume.

As the bench is 65 feet above the floor of Beaver Creek Valley there is dump for hydraulicking, unless the top of the boulder-clay is found to be unduly low at certain points in the western part of the bench.

There must have been a large, temporary flow of water down Beaver Creek Valley during the melting of the ice, and post-Glacial gold concentrations on this property were formed by it. It is also stated that values meriting investigation exist at various points in the gravel on the north slope of Beaver Creek Valley.

Black Creek.

Black Creek has engaged attention at different times, not so much because of the superficial placer deposits found in the bed of the creek, but because these deposits apparently resulted from a large buried channel that crosses the creek at right angles. The underlying presence of this channel is indicated by a pronounced but shallow depression whose surface lies about 750 feet above the Horsefly River. This channel is described in greater detail in the subsequent text.

The creek cuts across another wide depression which can be traced eastward and westward for some miles. It lies about 250 feet above the Horsefly River and appears to represent a former channel of it. It is separated from the Horsefly River Valley by knolls covered with gravel and is entirely floored with unconsolidated material. No investigation of it has yet been made so far as is known. There is no evidence that it is incised in rock or that it is of pre-Glacial age. It might possibly be of Pleistocene or later age, and might have been of brief duration, representing a flow of the river diverted from its course by the accumulation of glacial debris that must have formerly occupied its valley.

These channels, however, invest this region with interest because they invite further investigation to determine if dredging possibilities are presented.

Leases of Sig Johnson and Associates.

Five leases held by G. Armes, M. Armes, A. Armes, H. Armes, and G. Hockley are under option to Sig Johnson and associates, of Horsefly. The leases are on Black Creek, about 1 mile above its mouth. They cover a length of 1 mile and a total distance of 1½ miles east and west of the creek. The property is reached by a motor-road about 1 mile in length. It branches from the Horsefly-Black Creek road, at a point close to the end of the latter. The total distance from Horsefly is about 19½ miles.

Black Creek flows due south and drains the steep south slope of Black Mountain. Near the leases it cuts across a pronounced wide but shallow depression. The depression is about 750 feet above the Horsefly River, occupied by small muskegs, trending east and west across the creek. The creek then enters a short rock-walled canyon, from which it emerges to enter another canyon after flowing for a short distance in a valley in which no formation is exposed. The lower canyon, an outstanding topographic feature, is V-shaped, save in its upper part, and incised to a maximum depth of 175 feet. At the end of the lower canyon, before joining the Horsefly River, the creek flows across another wide depression occupied by extensive meadows, at an elevation of about 250 feet above the river. This depression is separated from the valley of the Horsefly River by gravel-covered knolls. It lies outside the above-mentioned leases.

The region is well covered with second-growth poplar and spruce, and underbrush. There are only occasional stands of good timber, as a bush fire swept through this area some years ago.

Where exposed the formation consists of andesite. There are three types of placer occurrence at this property: (*a*) A buried river-channel, presumably a former channel of the Horsefly River; (*b*) a buried creek-channel, trending south-eastward, apparently cut by Black Creek between the canyons; (*c*) placer deposits lying in the bed of the creek, and resulting from the reconcentration by Black Creek of either of the two first-mentioned.

(*a.*) The buried river-channel is indicated as underlying the wide, shallow depression mentioned. It is evidently a former channel of the Horsefly River, and was traced during the present examination westward as far as Patenaude (Marten) Lake and eastward to the Horsefly River Valley, a total distance of about 7 miles. It could possibly be traced farther westward, but time for doing so did not permit. Its eastward continuation, if such exists, beyond the Horsefly River Valley is not clear owing to the gap in the terrain due to erosion

by the river. Where cut by Black Creek, the depth from the surface to bed-rock has been determined by the drilling undertaken by the present operators of this property to be somewhat under 100 feet. The channel is undoubtedly incised in rock, because the south rim can be traced for a considerable distance east and west of Black Creek. East of the East Fork of Black Creek the depression lies north of a prominent rock knoll that separates it from the Horsefly River Valley. Assuming that the stated depth of bed-rock is correct, it is evident the bed-rock cross-section of the channel is wide and shallow, indicative of its slow cutting and age. It may quite possibly be a Tertiary channel, whose gravel is not exposed. Well-rounded quartz pebbles on the east shore of Patenaude Lake suggest a Tertiary channel, but any definite opinion as to age cannot be given until further information is gained. There is but little evidence of the gold values contained, beyond the fact that the channel is auriferous. It is cut not only by Black Creek but by the East Fork of Black Creek, and on both creeks old workings exist at or near the point of intersection. Reasons are given below why the results of Keystone-drilling in 1918 are not conclusive.

(*b.*) Part of a former channel of Black Creek is indicated as lying buried in the right bank of the creek near the lower end of the upper canyon. The former channel is apparently crossed obliquely by Black Creek. Its general trend is south-easterly, and its continuation may therefore lie in the left bank of Black Creek. Between the point of apparent intersection and the head of the lower canyon the depth to bed-rock on Black Creek is unknown. It has not yet been bottomed by the hydraulic operations. The down-stream continuation merits careful investigation.

(*c.*) Placer deposits in the bed of the creek were worked by early miners. Some were unworked; present operations are at or below the points of creek intersection of deposits (*a*) and (*b*).

The earliest operations on this creek were apparently those of early miners, mainly concerned with the superficial deposits in the bed of the creek. At that time three adits, all now caved, were driven in the right bank of the creek at or close to creek-level. One is below the upper canyon in the gap in the rim-rock, in the buried segment of the former channel of Black Creek, and the other two lie close together at the upper end of the upper canyon; the purpose of these last two was evidently to investigate the buried river-channel. In one of the latter it is stated that values of ½ oz. to the set were obtained. The results apparently did not invite continuation of the adits, or they were discontinued because of difficulties encountered.

In 1918 P. Fraser, for the Western Mines Exploration Syndicate, of Vancouver, put down five Keystone-drill holes at right angles to the direction of the channel at the top of the east valley-rim of Black Creek. In the Annual Report, Minister of Mines, British Columbia, 1918, it is stated that drilling did not disclose appreciable gold values, but that the deepest hole did not reach bed-rock. It is desired, however, to point out that if this channel is an old channel it is entirely reasonable to suppose that the gold would be mainly concentrated on and near bed-rock, and the upper gravel is likely to consist largely of glacial material, which is unlikely to carry appreciable gold values. The drilling was inconclusive because of the uncertainty of holes that did not reach bed-rock, and the incompleteness of one cross-section of holes. It is possible, of course, that this channel may have been eroded by ice. Some distance west of Black Creek glacial striæ indicating westward movement of ice were found in the rock forming the south rim of this channel. The continuation of the present operations on this creek should, however, afford much valuable information concerning this river-channel.

In 1927 this ground was owned by G. Mackeracher, and was in that year operated by him in a small way. In the following year the ground was acquired by Rountree Mines, Limited, plant was installed and hydraulicking commenced at the upper end of the lower canyon. Attempts to reach the bed-rock of the creek at that point failed then, and subsequently, in spite of efforts to reach it by blasting out a trench in the canyon and so lowering the sluice-flume. Hydraulicking was continued up-stream above bed-rock, but was discontinued after a few years.

In the early months of this year an option on the ground was obtained by Sig Johnson and associates, who first did some drilling with an Airplane drill (obviously the first necessary step) in that part of the creek where it crosses the buried river-channel. It is

stated that bed-rock was found at quite shallow depth, indicating that the bed-rock of the river-channel is somewhat under 100 feet below the surface, as given on the accompanying map. Accordingly preparations were made to hydraulic the bed of the creek and as much of the river-channel as it is found possible to reach. A storage-dam was constructed up-stream from the crossing of the river-channel, and the pipe-line was moved and installed in the new position. The monitor is set up at the south rim of the river-channel—that is, at the upper end of the upper canyon.

Undoubtedly the operations have been of very great informative value, and have greatly heightened interest in the possibilities of the exposed buried river-channel and, indirectly, in the lower buried channel.

Unfortunately, the water-supply is not suitable for any major hydraulic operation. Present operators derive the supply from Black Creek alone, and there is no satisfactory storage on the steep terrain whereby the run-off can be controlled.

The present abnormally dry season has greatly impeded the progress of the present operations, the results of which are likely to reveal facts of great importance.

Residual Gravel Exposures.—The widely-separated exposures of residual gravel, numbers 1 to 5 on the accompanying map, on an elevated plateau, are doubtless remnants of the Tertiary drainage of the Horsefly River and its tributary Moffat Creek. There are a number of reasons, however, apart from the fact that they are widely separated, why correlation cannot be made with any degree of certainty, and why inferences from these exposures must be drawn with caution. Moreover, as has been previously mentioned, a block to the north of Horsefly has been uplifted and tilted south-east. It is also quite possible that Moffat Creek had no existence in Eocene time, when interruption to flow was first occasioned by eruption of the Lower Lavas. Again, distance between the exposures increases uncertainty attaching to attempts to correlate.

There appears nothing incompatible with the suggestion that a large river resists with great obstinacy attempts to turn it aside from a former path. Some of these exposures may possibly be remnants of a path followed by the river after damming and before it was caused to flow by way of the *Miocene* channel. In that event there must be an underlying, still more deeply-buried remnant of the Horsefly River system antedating the extrusion of the Lower Lavas. The bed-rock of such a channel would be incised in an older formation than the Lower Lavas; an example is seen at the " Property of R. Blair."

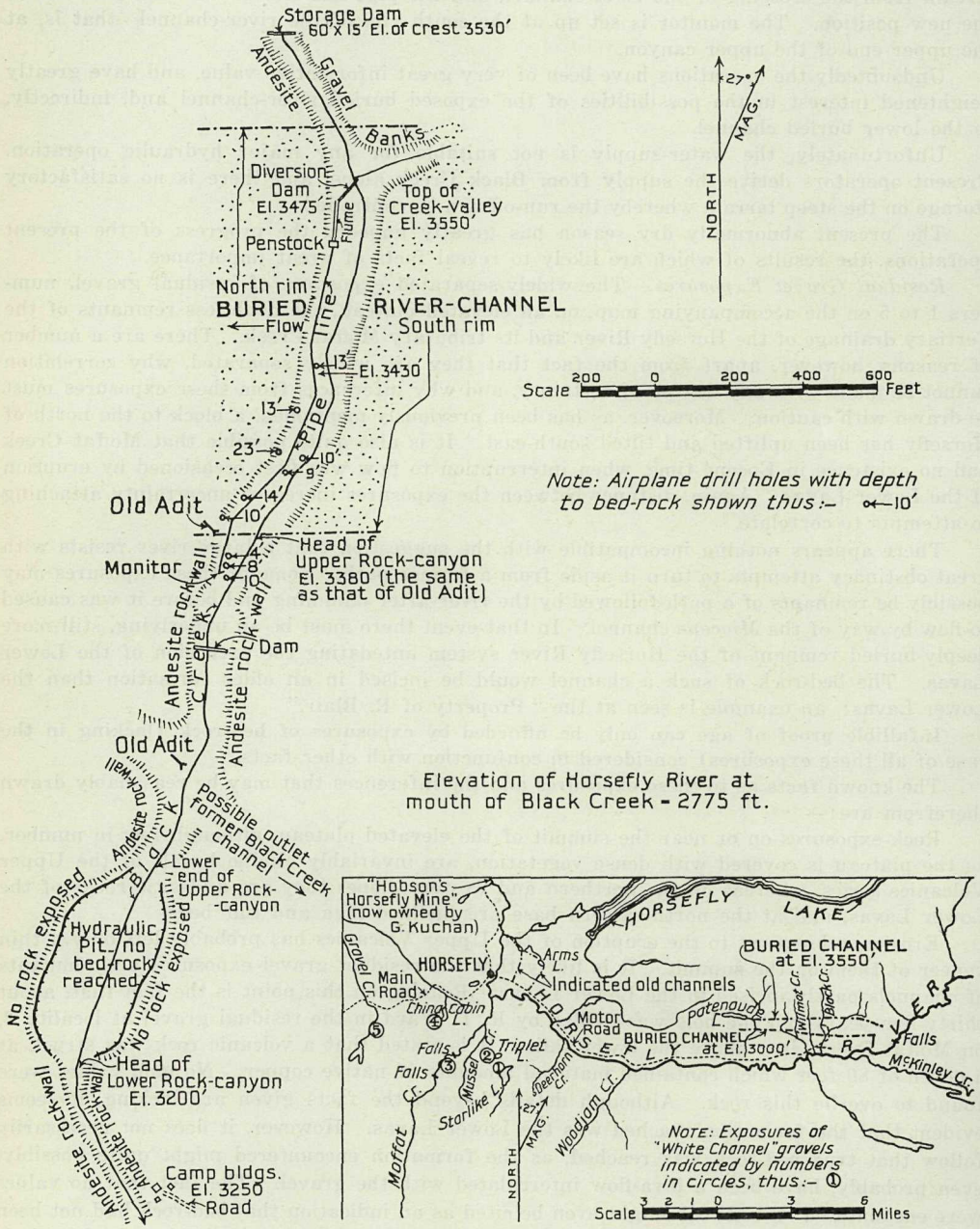
Infallible proof of age can only be afforded by exposures of bed-rock (lacking in the case of all these exposures) considered in conjunction with other facts.

The known facts as to these exposures and the inferences that may be reasonably drawn therefrom are:—

Rock-exposures on or near the summit of the elevated plateau, although few in number, as the plateau is covered with dense vegetation, are invariably olivine basalt of the Upper Volcanics series, whereas on the northern and western slopes they are andesitic rocks of the Lower Lavas, and at the north-eastern base are inclined lava and tuff beds.

Erosion subsequent to the eruption of the Upper Volcanics has probably left only a thin veneer of them on the summit. It is likely that the residual gravel exposures are remnants of channels partly incised in the Lower Lavas. Bearing on this point is the fact that, about thirty-five years ago one hole was drilled by R. T. Ward in the residual gravel at locality 3, on Moffat Creek, just above the lower falls. It is stated that a volcanic rock was struck at a depth of 80 feet which contained material amounts of native copper. No gold values were found to overlie this rock. Although details beyond the facts given are lacking, it seems evident that the formation reached was the Lower Lavas. However, it does not necessarily follow that true bed-rock was reached, as the formation encountered might quite possibly, even probably, have been a lava-flow intercalated with the gravel. The fact that no values were encountered on bed-rock might even be cited as an indication that bed-rock had not been reached, as the existence of no gold values on true bed-rock seems improbable. In fact, it is hardly assuming too much to say that available information concerning this drilling indicates, if anything, damming by the Lower Lavas, as true bed-rock could hardly be expected at the shallow depth cited.

In 1930 some Keystone-drilling was carried out by George Kuchan, J. Williams, and J. Mikklesen at Triplet Lake, locality 2. This followed the sinking of two shafts by way of



Sketch-plan of Horsefly Area and detail along Black Creek.

preliminary testing. One shaft, it is stated, reached a depth of somewhat over 40 feet and encountered a seam of lignite in the residual gravel. Exact drilling-data are not known to the writer, but it is stated that good values were encountered to a considerable depth below the surface. Below the auriferous gravels much lignitized material was met. Sulphurous water also, it is reported, issued from the drill casings. Sulphurous water was also observed by the writer at the time one of the shafts was being sunk some years ago. Possibly this originates from the decomposition of iron sulphide and its reduction by organic material. The presence of lignite and the residual gravel affords evidence of the Tertiary age of these deposits.

The reported presence of gold values in the upper strata is worth investigating. It is conceivable that sufficient yardage and values for a drag-line or dredging operation might be demonstrated, as there is a large area of residual gravel uncapped by volcanic rock. It is understood that one hole reached a depth of nearly 200 feet. The lignitic material encountered below the auriferous strata might indicate temporary lacustrine conditions.

Available information at this exposure is not discordant with the view that this might be a remnant of the Eocene channel of the river, dammed by the Lower Lavas and subsequently restored to its original course, before it was compelled to follow the *Miocene* channel. The Lower Lavas are not, of course, exposed, but the reported lignitic material suggests an arrested flow and their possible underlying presence. Presumably the once-existent capping of Upper Volcanics has been removed by erosion.

Exposure No. 4, on the south-west shore of China Cabin Lake, is in contact with reddish-coloured andesitic volcanic rock of the Lower Lavas. Quite possibly the channel rims, at any rate, are incised in that formation.

The one conclusive exposure is on Gravel Creek Canyon, previously described, where beds of residual gravel and intercalated lavas, of Upper Volcanics age, undoubtedly indicate a flow dammed by these lavas. The thickness of the overlying basalt suggests complete stoppage. Whether it is an exposure of the buried Horsefly River or its tributary is immaterial, as the presence of either indicates a flow at the time down the Beaver Creek Valley. This exposure, considered in conjunction with valley-fill occurrences of the Upper Volcanics at down-stream points (mentioned in Geological Survey, Canada, Summary Report, 1932, Part A 1, page 84), and exposures of the Lower Lavas at up-stream points (on leases of A. B. and R. N. Campbell), strongly supports the view that the flow in this valley was interrupted by two volcanic periods.

Evidence of Down-stream Continuation of Tertiary Horsefly River.—The possible presence of the buried Tertiary Horsefly River at down-stream points in the Beaver Creek Valley is suggested by placer deposits on Big Lake Creek (flowing northward into the valley) and by residual gravel exposed in Quesnel River Valley by early hydraulic operations three-eighths of a mile down-stream from Beavermouth. Additional facts must be secured before a former northward continuation of this river, in or adjacent to the Fraser River Valley, can be proved. It is significant that there is an ancient valley close to the Fraser River Valley on its east side. This valley is now occupied by Dragon and Ten-mile Lakes and the lower part of Canyon Creek. Evidence of a buried river crossing the Cottonwood River is cited on page C 19 of the Annual Report, Minister of Mines, British Columbia, 1936. Pertinent, doubtless, also is the presence of "Rich Bar" on the Fraser River, about 7 miles below Quesnel. The placer deposits of this bar, which engaged the attention of the early miners, are possibly due to the intersection of an ancient channel by the Fraser River. This view finds support in the evidence of the buried river-channel cut by Baker Creek, and described in this volume under "Property of R. Blair." It is possible, of course, that two different channels may have been occupied at different periods, in or near the Fraser River, owing to disturbances in Tertiary or earlier time.

Note re "Concretions" in the Horsefly River Valley.—A few comments seem to be called for respecting the curious disk-like objects, frequently found in the gravel in this valley. Although similar objects obviously originating in the same way are known to occur in other valleys, they are of some diagnostic value in correlating widely-separated channel-remnants of this river. The objects referred to consist, in most cases, of disks of laminated material about half an inch and upwards in thickness, locally termed "teapot-stands," for which purpose they are well fitted. In some cases they are spherical segments composed of similar

laminated material. Both types may or may not have a hole directly in the centre. These objects have been quite erroneously deemed " concretions," and have attracted considerable attention as they have an artificial appearance, accentuated in some cases, by remarkable approach to a circle. Similar but smaller objects, almost invariably with a hole in the centre, occur in immense numbers on Pesika Creek, a tributary of the Finlay River. A great many of these objects are being produced to-day on the Nechako River, a few miles from Vanderhoof. A visit some years ago to a clay deposit near there, aided by the investigation of the owner, G. Ogston, afforded convincing proof of the way in which these objects are produced. Invariably a great gulf of time is associated with the operation of mineral-forming processes; consequently, it is indeed surprising to learn that the time occupied in forming these objects is only a few seconds.

The required setting for their production is a bank of thinly-bedded material, slightly plastic, such as clayey slum, adjacent to a creek or river, but standing somewhat back from the water, so that there is a talus slope of considerable length at the base of the bank. Pieces of the bank become detached, roll down the talus slope and reach the bottom in the form of a cylinder, with more or less rounded ends. A high bank produces cylinders of smaller diameter than a low bank, as the rolling process is continued longer. In a number of cases, by pure chance, a cylinder is produced in which the laminæ are exactly at right angles to the long axis of the cylinder. Those that fail to reach the water dry out and split into a number of disks; the ends of the cylinder form the spherical segments. The disks and spherical segments harden, some are buried in situ, and in time become well indurated. Some disks, near the water, become fashioned by wave action into fantastic shapes. These have been erroneously deemed " fossils " by some.

In some cases a root of grass or other vegetation growing in the laminated material is detached with the piece that rolls down the talus slope. In some, this piece of root lies lengthwise in the centre of the cylinder formed. In such cases when the cylinder splits open on drying the root decays, and the result is a number of disks with a hole in the centre.

These objects could obviously be formed at any period given the right conditions, but in Pleistocene and post-Glacial times doubtless the number of slum deposits favoured their production.

Baker Creek.

Property of R. Blair.

A discovery claim, owned by R. Blair, of Quesnel, is at the lower end of Baker Creek Canyon, near the south boundary of Pre-emption Lot 8651. The property is 3¼ miles from Quesnel, and is reached by a road passable for cars. It follows Baker Creek Valley at creek-level, leads directly across this property and extends 1¼ miles farther, to the hydro-electric plant of Quesnel Light and Power Company.

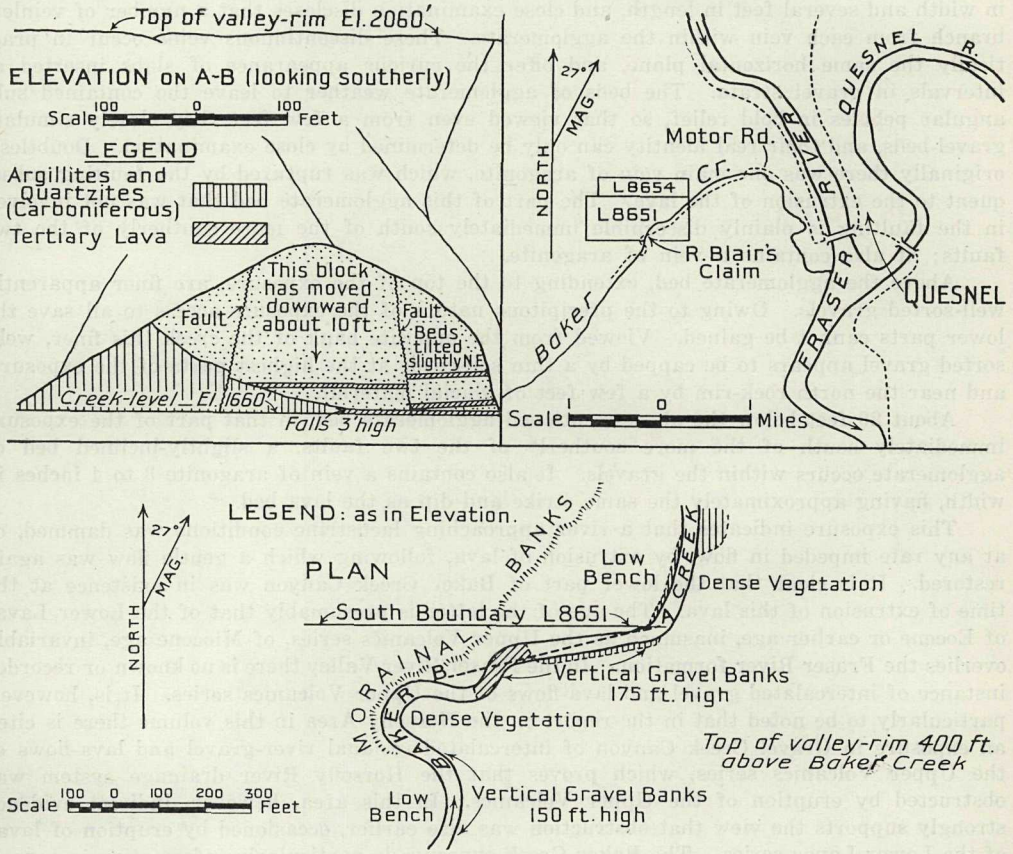
Baker Creek, at a point 1¼ miles above the property, is contained in a narrow rock-walled canyon incised to a depth of many hundreds of feet in the Fraser Plateau. Downstream the canyon becomes a gorge which merges in the wider valley. Both rock-rims are frequently and prominently exposed until they end and more or less abruptly at the lower end of this property, which marks the mouth of what is known as " the canyon." Farther downstream, for about half a mile, low-lying rock benches flank the creek; beyond, it winds through much glacial debris which mainly conceals the underlying formation. The valley is lightly timbered; the underbrush is dense save where the formation outcrops.

The geology is described by Reinecke in Geological Survey, Canada, Memoir 118, 1920. In the region examined this year the formation consists of interstratified much-folded quartzite and argillite (the latter carbonaceous in part) of the Cache Creek series of Carboniferous age. Conspicuous features of the valley are the numerous kaolinized rock-pillars of this formation on the north-west side of the valley, and the rampart-like exposures of basalt of the Upper Volcanics series of Miocene age, which cap the valley-rims and immediately underlie a shallow cover of glacial material.

The placer deposits at this property occur as: (*a*) A buried river-channel, exhibiting unusual features, cut deeply and approximately at right angles by Baker Creek; (*b*) post-Glacial concentrations on low-lying rock benches of Baker Creek, resulting from the intersection of the buried channel by Baker Creek.

The existence of this buried river-channel has apparently long been known. The Annual Report, Minister of Mines, British Columbia, 1899, records the fact that no work was done in that year by The Golden Province Mines Company, a company apparently incorporated for the purpose of investigating this channel. An old adit, known as "Law's tunnel," now caved, driven in the left bank of the creek and 50 feet above water-level, apparently marks this early mining effort.

In 1934 R. Blair discovered that the gravel on low-lying rock benches down-stream from the exposed river-channel was auriferous, and has since prospected at various points on his discovery claim.



Property of R. Blair, Baker Creek.

River-gravel with intercalated beds of volcanic agglomerate is exposed near the lower end of Baker Creek Canyon. It lies on the right bank of the creek, extends for a length of about 750 feet, and rises almost vertically to a maximum height of 175 feet above the river. The central part of the channel is obscured by dense vegetation which extends from creek-level, at 1,660 feet elevation, to the top of the steep valley-slope, at 2,060 feet elevation. At this point the river-gravel has been almost entirely removed from the left bank of the creek, which is flanked by a low-lying rock bench, at the back of which are banks of glacial debris.

The ancient gravel strata are faulted in the northern part of the exposure; there are two faults about 200 feet apart. It is evident that the block between the faults has moved downward about 10 feet. Owing to inaccessibility, the exact amount of movement could not be determined. The gently-sloping northern rim of the buried channel is composed of interstratified carbonaceous argillite and quartzite of the Cache Creek series of Carboniferous age. It is exposed almost to creek-level, where it is in contact with volcanic agglomerate and breccia over which the creek flows, and in which it has formed falls about 3 feet in height. The rim is exposed to a height of about 90 feet above creek-level, but is obscured by

dense vegetation; but as the Cache Creek sediments are exposed at a point 225 feet farther up-stream, the distance from rim to rim of the ancient channel at creek-level is probably not more than about 1,000 feet.

The material on the northern rim-rock consists of lignitized pieces of wood resting beneath clay-beds. Overlying the latter are beds of sub-angular gravel whose pebbles are 3 to 4 inches in diameter and consist mostly of lava. At about 35 feet above creek-level there is a more or less horizontal bed of volcanic agglomerate about 8 feet thick, in which are discontinuous veins of a fibrous mineral identified as aragonite, containing some manganese. This fibrous or columnar mineral is white in colour and translucent. Each vein is 3 to 4 inches in width and several feet in length, and close examination discloses that a number of veinlets branch from each vein within the agglomerate. These discontinuous veins occur in practically the same horizontal plane, and offer the curious appearance of slabs inserted at intervals in gravel strata. The beds of agglomerate weather to leave the contained sub-angular pebbles in bold relief, so that viewed even from a few feet they closely simulate gravel-beds, and their real identity can only be determined by close examination. Doubtless, originally there was one main vein of aragonite, which was ruptured by the faulting subsequent to the extrusion of the lava. The part of this agglomerate bed that was not involved in the faulting is plainly discernible immediately south of the more southerly of the two faults; it also contains a vein of aragonite.

Above the agglomerate bed, extending to the top of the exposure, are finer apparently well-sorted gravels. Owing to the precipitous nature of the exposure access to all save the lower parts cannot be gained. Viewed from the opposite bank of the creek this finer, well-sorted gravel appears to be capped by a thin soil-cover at the highest parts of the exposure, and near the north rock-rim by a few feet of glacial material.

About 20 feet below the above-mentioned agglomerate bed, in that part of the exposure immediately south of the more southerly of the two faults, a slightly-inclined bed of agglomerate occurs within the gravels. It also contains a vein of aragonite 3 to 4 inches in width, having approximately the same strike and dip as the lava bed.

This exposure indicates that a river approaching lacustrine conditions was dammed, or at any rate impeded in flow, by extrusion of lava, following which a gentle flow was again restored. It is clear that the lower part of Baker Creek Canyon was in existence at the time of extrusion of this lava. The age of the latter is presumably that of the Lower Lavas of Eocene or earlier age, inasmuch as the Upper Volcanics series, of Miocene age, invariably overlies the Fraser River formation. In the Fraser River Valley there is no known or recorded instance of intercalated gravel and lava-flows of the Upper Volcanics series. It is, however, particularly to be noted that in the report on the Horsefly Area in this volume there is cited an exposure in Gravel Creek Canyon of intercalated residual river-gravel and lava-flows of the Upper Volcanics series, which proves that the Horsefly River drainage system was obstructed by eruption of the Upper Volcanics. In this area, however, indirect evidence strongly supports the view that obstruction was also earlier, occasioned by eruption of lavas of the Lower Lavas series. The Baker Creek exposure is particularly informative in revealing conditions which must also have occurred in the Horsefly River Valley. Further light might also be thrown on the matter by a more detailed investigation of Baker Creek Valley than was possible at the time of the present examination.

The original direction of flow of water in this channel cannot be proved from the gravel-exposure itself, as there is no imbrication. A northward flow is, however, indicated by the direction of the Tertiary valley of Baker Creek. It is not in accord with a southward-flowing parent stream. Farther down-stream this creek bends around to flow south-eastward, winding through much glacial debris in a region where it is virtually in the Fraser River Valley. This bend is similar to that made by the Quesnel River in the same region.

It is of interest to note that the lacustrine conditions indicated by this exposure also find expression in the beds of diatomite on Pre-emption Lot 906, and other diatomite deposits to the north and lignite beds to the west and south. The general course of the channel, so far as is evident, appears to be northward and southward across Baker Creek. It would seem that the lacustrine conditions were promoted primarily by volcanic eruptions.

The commercial aspects of this property seem to lie chiefly in the low-lying rock benches flanking Baker Creek, immediately opposite and down-stream from the exposure of

Tertiary volcanics. These benches are underlain by argillite and quartzite of the Cache Creek series. On these benches may be expected superficial placer deposits resulting from the resorting of ancient channel gravel by Baker Creek. True bed-rock of the river-channel may be found under the rock bench on the left bank of Baker Creek, opposite the gravel-exposure, although the gravel thereon may be overlain by lava flows. A shallow pit exposes lignite on a low-lying rock bench on the left bank of the creek about half a mile down-stream from the channel-exposures. This may possibly mark another point on the rim of the river-channel and merits further investigation.

The owner reports encouraging values on rim-rock at the edge of the rock bench opposite the exposure, but, with the means available to him, has been unable to follow this gravel instream owing to inflow of water.

No systematic testing of the low-lying rock benches has been carried out. A small amount of drilling would throw much light upon the commercial aspects.

Distant 100 feet down-stream from the north rim of the river-channel, on the right bank of Baker Creek, a thickness of 4 feet of fine and coarse well-imbricated gravel, of possible post-Glacial age, rests on argillite. The imbrication indicates resorting by powerful northerly-flowing water. Behind this gravel the bank of the creek rises sharply to the top of the valley, but the nature of the material composing the valley-slope is entirely obscured by dense vegetation. At a point about 100 feet farther down-stream quartzite outcrops prominently and marks the end of Baker Creek Canyon. In the absence of further exposures it is not possible to express a definite opinion concerning the origin of this gravel, but it seems unlikely that there would be any active circulation of northward-flowing post-Glacial waters in this region other than those in Baker Creek Valley.

Cottonwood River and Lower Part of Swift River.

During the year about two weeks was occupied in an examination of the Cottonwood River, up-stream from that part examined in 1936. A general reconnaissance was made of the lower part of the Swift River, as far as the junction of Sovereign Creek, and the adjacent country on the north bank of the river.

The area is part of a strip of country some miles in width, trending north-west and south-east, between Wingdam and Likely, to which attention has previously been drawn in the publications of this Department. The formation underlying the area examined this year consists wholly of Mesozoic rocks.

An account of placer occurrences along the Cottonwood River, between the Quesnel–Barkerville and Prince George–Quesnel Road crossing, and particulars of roads and trails thereto, is given in the Annual Report, Minister of Mines, British Columbia, 1936.

The lower part of the Swift River is reached by the Foster Road, which branches from the Quesnel-Barkerville Road at a point about 2½ miles east of Cottonwood, crosses Lightning Creek at the boundary-line between Pre-emption Lots 437 and 438, and continues to the Swift River at Placer-mining Lease 2061, somewhat over 2 miles from the starting-point. The road is passable for cars in dry weather as far as Placer-mining Lease 2061, but onwards is only a wagon-road. On Placer-mining Lease 2061 the road ascends the right bank of the Swift River to the plateau, and continues on it for about 5 miles as far as Pre-emption Lot 1235, save for a steep descent to, and ascent from, Sovereign Creek.

An alternative route is by a road, passable for cars in dry weather, which branches from the highway at Coldspring House, 4½ miles east of Cottonwood, crosses Lightning Creek, and ascends the south bank of this creek to the plateau, where one branch leads to the property of H. G. Jamieson on Gagen Creek, and the other joins the Foster Road about 1½ miles from Lightning Creek.

The valleys of the Swift and Cottonwood Rivers are continuous; no topographic feature marks the end of one valley and the commencement of the other. The distinction is one in name only, the name Swift River being applied to the river above the junction of Lightning Creek.

Down-stream from the junction of Lightning Creek the Cottonwood River occupies a wide, well-timbered valley of mature relief. It enters a rock-walled canyon, about 2½ miles in length, commencing at the Quesnel-Barkerville Road crossing. This feature, coupled with the fact that a deep embayment trends instream north-westward for about half a mile

at the head of this canyon, on the north side of the river, plainly indicates that a pre-Glacial channel-segment of the river lies buried in the right bank. The down-stream end of this buried channel-segment coincides with the present valley between the 2-Mile and 3-Mile posts. There, old workings on the right bank of the river, near the boundary-line between the leases of A. M. Davis and associates, and those of E. McMillan and Mrs. McMillan, indicate the intersection of the former channel by the river. The canyon is largely, if not entirely, of post-Glacial age, although incision may have commenced in Pleistocene time.

The formation exposed in the canyon consists of alternating bands of sediments (chiefly argillite) and volcanic rocks. This assemblage is intruded at several points by tongues of porphyritic diorite, and at one point by granodiorite. Argillite on the left bank of the river, between the 2-Mile and 3-Mile posts, is fossiliferous, and at one point contains a well-preserved impression of an ammonite, about 8 by 5 inches. No quartz veins of appreciable size were observed in the region, although outcrops of existing veins may be concealed by vegetation or glacial debris.

The Swift River, at and down-stream from Sovereign Creek, occupies a steep rock-walled gorge 2 miles or more in length and incised to a depth of about 200 feet in the plateau. Down-stream from the gorge the right bank rises abruptly from the river to the plateau which flanks it for a further distance of about 1 mile. It then merges in a large flat a few feet above river-level. The left bank is flanked by a gently-rising valley-slope which opens out to another large low-lying flat on that side of the river. These two flats are covered by Placer-mining Leases 2061 and 2062. At the down-stream end of the former, about three-quarters of a mile above the junction of Lightning Creek, the river flows through a short low-walled rock-canyon in its valley, which reaches a width of about 1,500 feet in this section. Lightning and Sovereign Creeks, flowing westward, parallel to each other, between 3 and 4 miles apart, also occupy rocky gorges of considerable length that are incised to a depth of about 200 feet in the plateau. The one on Lightning Creek ends about 1½ miles above its junction with the river. The canyons and gorges on the Swift River, Lightning, and Sovereign Creeks are all of post-Glacial age.

The Swift River Valley is well timbered, and rock-outcrops are infrequent on the plateau; they are obscured by vegetation and glacial debris. The latter is probably not thick except locally. The formation is well exposed in the gorges and consists of alternating bands of sediments, chiefly argillite, and volcanic rocks. These rocks are intruded by tongues of acid igneous rock on the Swift River, and by hornblende-diorite in Lightning Creek Gorge, in the hydraulic pit on Gagen Creek, and also on Sovereign Creek. Quartz veins do not appear to be numerous in the region, although they may be obscured by vegetation and glacial debris. Some are exposed in the hydraulic pit on Gagen Creek; one vein is 4 feet in width.

From the topography it is clear that the region to the east of Swift River has been subjected to post-Glacial uplift. It is indicated that former north-westward-flowing streams, on the plateau adjacent to the right bank of Swift River, have been subjected to stream piracy. In rejuvenating, the Swift River appears to have shifted west of its former course. Indications of earlier channels of this river exist on the plateau in the form of depressions, trending more or less parallel to the river, and occupied mainly by meadows and swampy ground. Chief of these are the "Moose Pasture," immediately south of Sovereign Creek, a depression about 2 miles in length, in which is situated a lease owned by G. S. Gagen; another marked depression about 1 mile in length, occupied by a small creek entering Swift River 2 miles below Sovereign Creek; and the depression now occupied by Lost Valley Creek, which may be the north-westerly continuation of the first-mentioned.

Placer deposits in this area occur as:—

(1.) Post-Glacial concentrations on indurated false bed-rock material, consisting mainly of inter-Glacial slum and gravel deposits. The Cottonwood River Valley is floored with such indurated material for a distance of not less than 10 miles, and the Swift River Valley for a distance of about 1 mile in the part examined.

(2.) Buried channels, indicated as lying instream on both rivers.

(3.) Post-Glacial concentrations of a different type to that cited under (1) above, and also buried channels, exhibited at individual properties, such as that of H. G. Jamieson, on Gagen Creek.

Of these, the first two are the most important commercially, and warrant considerable investigation.

Both the Cottonwood and Swift River Valleys are underlain apparently for considerable distances, save in the canyons, by indurated material, chiefly slum and gravel. It is thought to be mostly of inter-Glacial age, and on it post-Glacial deposits of auriferous gravel of comparatively shallow depth have been laid down in the bed of the river and on low-lying flanking benches. Indurated material underlies the Cottonwood River Valley, up-stream from Pre-emption Lot 9670, as far as the lower end of the post-Glacial canyon, down-stream from the Quesnel-Barkerville Road crossing, and is possibly present in the valley above this road-crossing, but time was not available for examination of that part of the river. In the Swift River Valley, in the vicinity of Placer-mining Leases 2061 and 2062, the bed of the river and large benches on both banks are floored with indurated slum.

This deposit is important, for although gold values are known to vary widely at the different points it forms a false bed-rock of wide extent and underlies a large volume of gravel. Detailed testing is warranted to ascertain if dredging or drag-line possibilities are offered, either locally or considering the valleys of these rivers as a whole. The physical properties of the indurated material are favourable to either type of operation.

Because the deposits forming this false bed-rock are well indurated, resemble glacial rather than Tertiary deposits, and contain small seams of lignite, they would appear to be mainly of inter-Glacial age. It is, of course, quite possible that some exposures may be Tertiary. The seams of lignite are of considerable value in tracing this deposit up-stream. The presence of well-carbonized lignite in unconsolidated material in the lower part of Lightning Creek Valley, near Coldspring House, has long been known. It is understood that some lignite was used as fuel in the early days of mining. This lignite was apparently obtained from the south bank of Lightning Creek, opposite Coldspring House, and detailed mention is made of it on page 29, Geological Survey, Canada, Memoir 149, 1926. This exposure has apparently been subsequently covered up, or washed out by the river, as no evidence of it could be found this year. In 1934, Keystone-drilling for placer on the eastern part of Pre-emption Lot 443 disclosed lignite beds of great thickness in unconsolidated material on the north bank of the creek. Last year application was made for rights in this region, under the "Coal and Petroleum Act," by Consolidated Gold Alluvials of British Columbia, Limited, with a view to the possible utilization of this lignite as fuel at Wingdam. This company, in 1937, drove an adit on the right bank of Lightning Creek, about 15 feet above creek-level, at the base of the flat on which the Keystone-drilling was done. The adit is 21 feet in length and is driven on a bearing north 5 degrees east, in line with a row of holes drilled on a due north bearing. It discloses for its entire length interstratified clay and lignite beds, apparently striking due east and dipping south at 45 degrees. Near the portal the overlie is only 2 feet in thickness and consists of soil and gravel. Whether this lignite is in place or not is indeterminate from the exposure. There is a likelihood, however, that the lower part of Lightning Creek Valley is floored with inter-Glacial deposits.

There is much evidence of early mining of post-Glacial bench deposits. Some of these are quite extensive, notably on the right bank of the Cottonwood River, somewhat above the 3-Mile post (where the river cuts across its former channel, previously mentioned as lying buried in its right bank, up-stream from this point); on the right bank of Lightning Creek, up-stream from the mouth for about 1½ miles; and on the right bank of Swift River immediately down-stream from Sovereign Creek. Subsequent to these early operations, the numerous bars and benches of the Cottonwood and Swift Rivers have long engaged the efforts of numerous prospectors at favourable stages of water.

On Placer-mining Leases 2061 and 2062 on the Swift River, Keystone-drilling was carried out by G. A. Dunlop in 1922. In Geological Survey, Canada, Memoir 149, page 177, it is stated: "In all, thirty-six holes were put down. All the gold is in the surface gravels, which average 13 feet in thickness and have a maximum depth of about 25 feet. Two or three holes were put down about 75 feet, but did not reach bed-rock, the surface gravels being underlain by hard silt and boulder-clay carrying no gold. Mr. Dunlop estimates that the drilling proved approximately 4,000,000 yards of ground having an average value of 31 cents a cubic yard. The surface is fairly heavily timbered in places, but a large part is grass land. The surface gravels are fairly coarse, but contain few, if any, large boulders. The gold is concentrated

mainly on the clay, the surface of which is nearly level, and is mostly flaky, but not very fine, and is easily saved." A suction-dredge, from which favourable results were hardly to be expected, was installed on this ground in 1924, but this operation was short-lived. On the same ground, in 1932, C. H. McDonald installed a Sauerman high-line plant that was not in operation for any length of time. Subsequently this ground has lain idle.

In 1932 attention was directed to the plateau immediately south of Lightning Creek by G. S. Gagen's discovery of rich superficial gravel on the right bank of Gagen Creek. Subsequently, Sovereign Creek Gold Mines, Limited, incorporated in 1934, acquired this ground, brought in a water-supply by ditch and flume from Sovereign Creek, installed plant, and commenced hydraulicking. The latter was of short duration, and confined to an area about 500 by 375 feet. This ground was acquired in 1936 by H. G. Jamieson, who has since done considerable testing. The property is described in the Annual Report, Minister of Mines, British Columbia, 1934, pages C 28 and C 29.

This year a considerable amount of systematic testing was done by W. J. Noon on the leases of E. McMillan and Mrs. McMillan, on the Cottonwood River (described in Annual Report, Minister of Mines, British Columbia, 1936, pages C 27 and C 28). A number of shallow shafts were sunk by the caisson method, followed in the late autumn by Keystone-drilling. The result of this investigation is not fully known to the writer.

The origin of the gold in the post-Glacial deposits of this area is a matter of considerable interest and importance. At certain points it is due to intersections of earlier channel-segments. Below Wingdam numerous old workings on Lightning Creek indicate the existence of post-Glacial deposits not attributable to channel intersection.

During the year, the operations of Consolidated Gold Alluvials of British Columbia, Limited, have demonstrated that the gold in the rich bed-rock gravel of Lightning Creek at Wingdam is of exactly the same character as that in the up-stream higher-lying gravel, of presumably inter-Glacial age, which constitutes the Sanderson mine. The post-Tertiary age of the bed-rock gravel has been established by fossil evidence. The rich bed-rock deposits are indicated as having resulted from resorting of the inter-Glacial gravels. The latter must have resulted from resorting of glacial material, and the size of the deposit at Wingdam indicates the large amount of rich debris which must have been resorted.

With regard to a possible local source of gold to which placer occurrence, generally within the area, might be attributable, reference is invited to the Annual Report of the Minister of Mines, British Columbia, 1933, pages 115, 116, and 117. It will be noted that the Mesozoic rocks bordering those of Precambrian age on the west are invaded at a number of points by stocks and tongues of the Central batholith. Instrusives also occur in the Precambrian rocks. The fact that in the south-eastern part of this area auriferous quartz veins occur in both Precambrian and Mesozoic rocks suggests that this may also be the case, at other points, along the Wingdam-Likely belt.

Leases of W. D. and J. W. Jones and Associates.

Six Placer-mining Leases Nos. 3783, 3784, 3834, 3831, 3899, and 3900, held by W. D. and J. W. Jones and associates, of Cottonwood, are situated on the Cottonwood River at and down-stream from Umiti (Deep) Creek. The ground covered lies mostly on the north side of the river, and on Umiti Creek. The property is reached either by a go-devil trail, 3½ miles in length, which branches from the Quesnel–Barkerville Road at the top of 18-Mile Hill, 18 miles from Quesnel, or by a pack-trail, 7 miles in length, which branches from the Quesnel–Barkerville Road at the bridge across the river and follows the north side of the latter. The go-devil trail is the only route over which any heavy supplies can be taken to the property. It crosses the plateau in a northerly direction, descends the river-valley on a fair grade, and reaches the river opposite Umiti (Deep) Creek.

Up-stream from Umiti (Deep) Creek for somewhat less than a quarter of a mile, and down-stream from this creek for about half a mile, there is an extensive bench, terraced in part, that rises above river-level to a maximum height of 35 feet. This, so far as is indicated by such testing as has been carried out to date, is underlain by indurated material at an average depth of 10 to 12 feet. The overlie consists of an upper stratum of barren silt up to 4 feet in maximum thickness, overlying post-Glacial auriferous gravel lying on the false bed-rock. It is stated that nine pits sunk at various points on this flat indicated encouraging values. At certain points near the river considerably better values have, it is stated by the

owners, been obtained. At one point, from 800 cubic yards of gravel gold to the value of $1,200 is reported to have been recovered.

At the back of this bench, west of Umiti (Deep) Creek and about 25 feet above it, there is another bench, about half a mile in length and about 300 yards in width. It is underlain at its east end by indurated material and near its west end by altered andesite, a formation that is prevalent in this region. This higher bench is partly covered by the leases and partly by one held by David V. Sanders. Rock-exposures on it are scanty, but there is concentration of gold on the false bed-rock and on the altered andesite. The overlie of well-washed gravel is from 15 to 18 feet in thickness, with a certain amount of silt and surface soil on top.

Considerable work has been done on the south side of the river directly opposite Umiti (Deep) Creek. Bench deposits overlie indurated material; values are stated to be good, but considerable trouble was experienced owing to sloughing of the valley-slopes over working-faces.

Down-stream about half a mile from Umiti (Deep) Creek a large U-bend of the river surrounds an extensive low-lying bench on three sides. No great amount of testing has been done on it, but it is of potential promise and warrants testing. Opposite one side of this bench, on the north side of the river, there is another low-lying bench of considerable size, and down-stream on both sides of the river there is a considerable amount of low-lying bench-ground that warrants testing.

It is considered that sufficient testing has been carried out to date to warrant more detailed investigation to determine if dredging or drag-line possibilities exist.

Lease of S. Svenson.

One lease, owned by S. Svenson, of Cottonwood, is on the right bank of the Swift River, adjoining Placer-mining Leases 2061 and 2062, about 2½ miles down-stream from Sovereign Creek. It is reached either by a foot-trail, about half a mile in length, that follows the right bank of the river from Placer-mining Lease 2061, or by a branch trail, a few hundred yards from the Foster Road, that passes along the plateau immediately above the workings, on the right bank of the river.

The lease covers a somewhat irregular low-lying bench varying in width from 50 to 150 feet, flanking the right bank of the river, at the back of which the river-bank rises sharply at most points to the plateau, about 210 feet above the river. There is a very marked large depression trending south-eastward from the river-bank and outer edge of the plateau. It becomes rapidly shallower and less distinct on the plateau. The region is well timbered and there are no bed-rock outcrops in the immediate vicinity.

The placer occurrence at this property consists of post-Glacial concentrations on indurated glacial material immediately adjacent to the river and resorted by the river. Instream in the pits, auriferous gravel overlies hard-pan and is overlain by boulder-clay and glacial material. It therefore must be of Pleistocene or earlier age, unless the boulder-clay has sloughed to its present position after the gravel was resorted by the river. The gold is fairly coarse, one nugget valued at $4 is stated to have been recovered. The owner states that when one lot of placer gold weighing 71 dwt. was screened, it was found that 44 dwt. failed to pass a 16-mesh screen. The coarse character of the gold, coupled with the existence of the depression in the river-bank at this point, suggests that the source of the gold may be from a tributary channel, but insufficient work has been done to pass a definite opinion on this point.

The workings lie along the river-bank within a distance of somewhat over 300 feet. By using the water supplied by an underground spring, the owner has opened up two pits by ground-sluicing, aided by shovelling. The face of the down-stream pit exposes 10 feet of glacial debris overlying a 5-foot stratum of poorly-sorted cemented gravel, which in turn overlies 15 feet of washed but poorly-sorted auriferous gravel. No bed-rock, true or false, is exposed beneath the lowest gravel.

The up-stream pit is about 75 by 75 feet in size. The pit-face exposes 2 to 3 feet of well-washed auriferous gravel underlying 15 feet mainly of boulder-clay, and overlying indurated finer gravel and clay or hard-pan. About 3,000 cubic yards of material has been removed from this pit, from which the owner states that about 20 oz. of gold was recovered.

At a point 120 feet up-stream from the last ground-sluice pit and 6 feet above river-level, the face of a 5-foot adit at the end of a 60-foot open-cut exposes hard-pan overlain by 3 feet of washed gravel and 3 feet of surface debris.

Morehead Creek.

Priority Mines, Ltd.

The property of this company consists of three claims and two leases, situated on Morehead Creek, about 3 miles below Morehead Lake. It is reached by a motor-road, 2½ miles in length, which branches from the main road to Likely, immediately north of Morehead Lake. Morehead Creek flows from Morehead Lake north-westward in a well-timbered valley of mature relief for about 2 miles before it is joined by Warran Creek, which drains the extensive flat terrain to the west. Somewhat over half a mile below this point Morehead Creek cascades over falls, turns sharply, and from this point to its junction with Little Lake Creek trends north-east in a steep-sided valley, some hundreds of feet in depth. In this valley the rock-walls are continuous save for a length of somewhat over 500 feet, commencing 2,700 feet below the falls. Although the banks of the creek's containing-valley are steep at all points, on the left bank at the up-stream end a gap in the rock-walls about 250 feet in length is occupied by a steep bank of clayey gravel. The right bank is flanked by a flat 10 feet above the creek, about 100 to 150 feet in width, at the back of which is a small bench of maximum width 50 feet, at a height of 40 feet above the creek. Behind this rises the steep eastern valley-slope, the underlying formation being obscured for a distance of several hundred feet by dense vegetation. The formation outcrops again on the right side of the creek at the down-stream end of the low-lying flat where the creek again cascades over falls. The superficial placer deposits found on this flat engaged the attention of the earliest miners, and to this part of the creek mining effort has been subsequently confined, and on it the present operations are centred.

The geology of this region is described in Geological Survey, Canada, Summary Report, 1932, Part A 1, pages 81 and 82, and on pages 101 and 102 an account is given of this property.

The formation exposed in the vicinity of the workings consists of volcanic rocks.

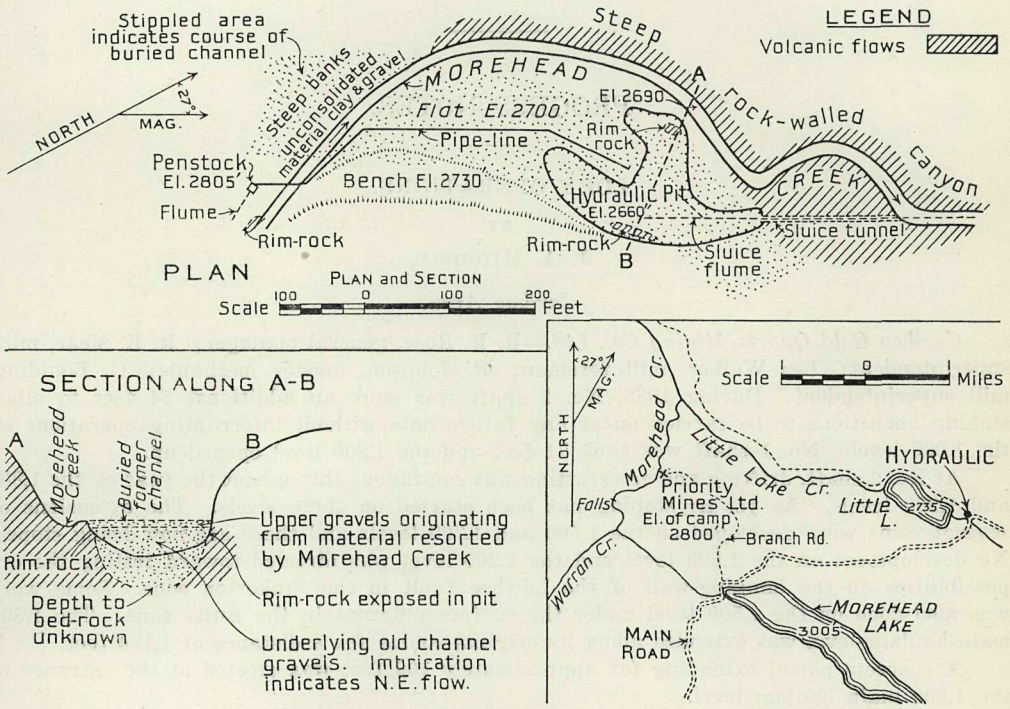
The placer deposits at this property occur as:—

(*a.*) A buried channel of prevailing north-easterly flow, cut obliquely by Morehead Creek.

(*b.*) Post-Glacial deposits on the low-lying bench on the right bank of the creek near the intersection of the buried channel. These attracted the attention of the early miners, and were formed by Morehead Creek in cutting through the upper gravel-strata of the buried channel, and such overlying glacial debris as must formerly have occupied the valley.

The superficial placer-deposits on the low-lying flat flanking the right bank of the creek must have been largely worked out by the earliest miners, who left no evidence apparently of any attempt to reach bed-rock. In the eighties, R. D. Davis endeavoured to reach the bed-rock of the buried channel by sinking, at the northern end of the flat. He failed because of the water encountered. Subsequently a tunnel driven at the base of the falls below the flat proved to be above bed-rock in the channel. In more recent years the ground was acquired by S. Prior, who utilized water from Morehead Creek to wash some of the upper gravel strata. In 1933 the property was acquired by Priority Syndicate, which was recently incorporated as Priority Mines, Limited. This syndicate and company drove a tunnel 150 feet in length, below the former tunnel at 2,625 feet elevation, through the rock that forms the right bank of Morehead Creek, and penetrated the left rim of the buried channel above bed-rock. A storage-dam was constructed on Warran Creek, and a supply of water for hydraulicking brought in by a flume from the top of the upper falls on Morehead Creek. The penstock at the end of the flume, at 2,805 feet elevation, gives a head at the monitor of 145 feet. By placing a sluice-flume in the tunnel and continuing the sluice-flume beyond the tunnel in Morehead Creek a further distance of 400 feet a considerable yardage of upper gravel has been piped out. The maximum depth of the hydraulic pit at the head of the sluice-flume, below the low-lying flat, is 40 feet. It has been found that to continue hydraulic operations it will be necessary to lengthen the sluice-flume, owing to the accumulation of tailings. It is therefore proposed to increase the length by another 1,500 feet, and to put steel plates in the lower end. The grade of Morehead Creek to its junction with Little Lake

Creek has been ascertained by the management as being 3.7 per cent. No attempt has been made by this company to reach bed-rock, because it is considered that as bed-rock gravel can only be mined by some form of drag-line installation, the removal of a large amount of overlying gravel is the first step necessary. It is therefore the intention to continue hydraulicking to afford the necessary space to accommodate a drag-line, should investigation of bed-rock values be found to justify its installation. Encouraging values are reported in the overlying gravel.



Priority Mines, Limited, Morehead Creek.

It is clear that up-stream from the workings this channel lies buried in the left bank of Morehead Creek. From examination of the region it seems likely that the up-stream continuation lies considerably instream from Morehead Creek, in a direction about south 39 degrees west from the hydraulic pit. Down-stream from the workings, the continuation of the buried channel lies in the right bank of Morehead Creek, and presumably it emerges in Little Lake Creek Valley. It seems likely that this buried channel is a former channel of Warran Creek, which was then a tributary of Little Lake Creek. Both rims of the buried channel are exposed in the hydraulic pit, but the bed-rock is not, and its depth is unknown beyond that it is below Morehead Creek. It is apparent that the canyon of Morehead Creek is largely of post-Glacial age, although incision may have been commenced in inter-Glacial time. Exposures are as yet inadequate for one to form an opinion as to the age of the buried channel, but the well-imbricated gravel leaves no doubt that the direction of flow was north-eastward.

It is apparent that within the hydraulic pit and that part of the creek under investigation, all gravel, and any once-existent glacial material, has been well resorted down to the level of Morehead Creek by this creek. It is only on the north-eastern edge of the hydraulic pit and at the up-stream end of the low-lying flat that glacial overlie is exposed. It is heavy at these points, but operations are not now concerned with it.

The cross-section of gravel in the pit shows that hydraulic operations have gone beneath the range of sorting by Morehead Creek water and have exposed the well-washed coarse and fine gravel of the ancient channel. These gravels show pronounced imbrication indicative of an original north-easterly flow of water. In these gravels are layers of indurated gravel,

which serve as false bed-rocks and prevent gold from sinking in the course of hydraulicking. The overlying gravels, resorted by Morehead Creek, have a maximum thickness of about 22 feet, and are composed of the following strata: At the top, a bed about 4 feet in thickness of sorted gravel with a few large boulders; below this 6 feet of medium-size and fine well-washed gravel; below this, a 2-foot bed of sand; and at the bottom about 10 feet of coarser well-washed gravel. The gravels are derived partly from local rocks and partly from rocks foreign to the immediate vicinity.

PROGESS NOTES.

LODE OPERATIONS.

BY

J. A. MITCHELL.

Cariboo Area.

Cariboo Gold Quartz Mining Co., Ltd.—R. R. Rose, general manager; R. E. Vear, mine superintendent; Les Walker, mill foreman; P. Johnson, master mechanic; C. Boulding, mill superintendent. During 1938, No. 2 shaft was sunk an additional 54 feet to allow sinking operations to be carried on at any future date without interrupting operations on the 1,900 level. No. 1 shaft was sunk 71 feet and the 1,800 level opened up.

At No. 2 shaft, drifting and crosscutting was continuous throughout the year on the 1,800 and 1,900 levels. As yet no stoping has been started on these levels. The extensions of several veins were developed on the 1,500 and 1,700 levels and these are now being stoped. No development on the 1,500 level and the 1,200 level was directed toward testing the ore possibilities on the hanging-wall of the Lowhee fault in the Pinkerton zone. Some work was also done on the 1,500 level under the surface outcrops in the Butts zone. The 1,500 main haulage-level was extended along its original course for a distance of 1,194 feet.

A concrete portal extending for approximately 100 feet was erected at the entrance of the 1,500 main haulage-level.

Underground development during the year consisted of 7,065 feet of drifting, 7,665 feet of crosscutting, 1,281 feet of raising, 125 feet of shaft sinking, and 10,355 feet of diamond-drilling.

On the average throughout the year 212 men were employed underground, thirteen in the mill, seventy-nine on the surface, and there were thirty-two salaried officials.

During 1938, milling was at the rate of 250 tons per day for January and February, and then stepped up to 275 tons per day. During August and September the tonnage was generally increased to 300 tons per day in October, at which rate it has been maintained. A total of 102,539 dry tons of ore was milled in 1938, with a production of approximately 42,808 fine ounces of gold and 3,249 oz. of silver.

In the power-house a Clarkson-Thimble exhaust-heat boiler was connected to the 375-k.v.a. unit. There are now two of these in operation.

On the surface, additions were made to the machine-shop, dry- and bunk-houses.

Island Mountain Mines Co., Ltd.—M. D. Banghart, manager; T. H. Munn, general superintendent; E. W. Johnson, mill superintendent; H. Hewat, mine superintendent. The mine and mill operated continuously during the year. The mill, which has a daily capacity of 125 tons, treated a total of 44,916 tons of ore during the year and produced 18,351 oz. of gold and 2,637 oz. of silver.

Stoping operations and development were carried out over a vertical range of 750 feet, from 250 feet above the main or 4,000 level to 500 feet below the main level, with development being vigorously advanced on the bottom or 3,500 level. During the latter part of the year and the first two weeks of 1939, the main operating shaft was deepened to 1,079 feet below the collar and additional levels opened at the 3,375, 3,250, 3,125, and 3,000 elevations. During the year 7,364 feet of drifting and crosscutting, 1,300 feet of raising, 473 feet of

shaft sinking, 147 feet of shaft stations and pockets, and 23,233 feet of diamond-drilling were done.

The average number of men employed underground and on the surface throughout the year was 111 men.

Cariboo Consolidated Mining Co., Ltd.—This property did not operate during 1938.

Cariboo Thompson Gold Mines, Inc.—C. E. Gordon Brown, manager. A small crew, maximum 10 men, was employed during the year in erecting camp and driving tunnel.

The *Cariboo Thompson* property adjoins the holdings of the Cariboo Hudson Gold Mines, Limited, and the camp is below the Hudson mine-road, about 22 miles south of Barkerville.

Comfortable living-quarters were established and other buildings are contemplated. A 321-foot crosscut was driven and intersected the objective, a small quartz vein occurring in a north-striking fault-fracture which is well mineralized with finely-crushed pyrite. This vein has been followed by drifts respectively 35 feet north and 98 feet south from the crosscut.

A small fan has been installed to control the ventilation in the drifts.

Cariboo Hudson Gold Mines, Ltd.—J. D. MacDonald, superintendent. During the year development-work was continued on the 200 level, a 100-foot winze was driven, and the 250 and 300 levels were started from this winze. A raise-connection on the vein was made between the 300 and 250 levels.

From the Simlock Creek side the 600 level crosscut, 400 feet below the 200 level, was driven. This drive intersected several quartz veins including what is considered the downward continuation of the main vein on the 200 level. A raise is now being driven on this vein between the 600 and 200 levels.

During the year numerous necessary additions were made to the camp. A 100-ton mill was erected and at the end of the year this mill was treating 50 tons daily.

Bralco Group.—E. Parr, engineer in charge; E. Hansen, superintendent. The Pioneer Gold Mining Company of B.C., Limited, took an option of this property which adjoins the *Cariboo Hudson*. A crew of fourteen men was employed at surface-stripping, but results were discouraging and the option was relinquished.

Snowshoe Gold Mines, Ltd.—John Matson, mine manager. The *Snowshoe* is a new operation financed by Fred Wells and associates. The property is 1 mile north of Yanks Peak and is approximately 7 miles due west of the *Cariboo Hudson* mine.

An extensive building programme, including bunk-house, power-house, warehouse, blacksmith-shop, and dry was completed during the latter part of the year. A small steam-sawmill was erected to cut lumber for the camp construction and will be used for future contemplated extensions to the present camp.

Preparations are being made to carry out an extensive development plan using power-drills, but to date the main exploration adit has been advanced by hand-drilling approximately 100 feet into the hill.

A Diesel engine and Ingersoll-Rand compressor are on the ground but are not yet installed. A crew of twenty-nine men is employed at the camp.

During the year a Government road was laid out from Barkerville over the main divide to Keithley. A considerable amount of grading has been completed.

About 250 tons of freight, chiefly mine-supplies, were taken over this road to the Snowshoe camp. Diesel caterpillar-tractors were used for grading the roads and hauling the freight.

The development adit now being driven will cross some of the smaller veins and tap the larger quartz-bodies at considerable depth.

Cariboo Midas Mines, Ltd.—(Amparo Mining Company, Inc., Philadelphia, U.S.A.) J. B. Knaebal, manager; P. Behnsen, superintendent. In the late fall operations commenced at this property, which is near the summit of Yanks Peak on the north slope, and an extensive building campaign was under way at the end of the year.

The present programme calls for a 1,000-foot adit. Fifteen men on three shifts are employed in driving this heading. A 3800 Diesel and compressor have recently been installed to supply compressed air to the drills. The adit is in 290 feet and is ventilated by a gasoline-driven blower and 8-inch vent-pipe.

Supplies at first were freighted in from Barkerville over the road leading to the *Snowshoe* mine, but are now brought in via Keithley then to the mine on pack-horses.

Quesnelle Quartz Mining Co., Ltd.—T. Norton Youngs, manager; Russell Ross, general superintendent. In the period from June, when underground operations were resumed, until the end of the year, the following development-work was accomplished at this mine: 192 feet of drifting; 192 feet of crosscutting; 251 feet of raising. In addition, several stopes were opened up and equipped with chutes and manways. A complete assay plant is maintained at the property and an intensive sampling programme has been carried out.

During the summer a cyanide plant was constructed and put into operation on November 27th. The milling equipment consists of a 275-ton coarse-ore bin at the head of the surface tram from the mine-shaft head, a 9- by 15-inch Allis-Chalmers jaw-crusher, and a 40-foot conveyor to a 100-ton fine-ore bin.

The 4½- by 7-foot Allis-Chalmers ball-mill is driven by a 75-horse-power General Electric motor and operates in closed circuit with a 3- by 15-foot Dorr Simplex classifier. The classifier overflow is sent by gravity by a 12- by 19-foot Dorr combination washing-thickener (top tray), then to two 10- by 14-foot Dorr agitators, and back through the second, third, and fourth compartments of the thickener before being pumped to the tailings launder. The gold solution is clarified and treated in a Merrill-Crowe, bog-type, precipitation unit. The precipitate is refined in a Monarch tilting-pot furnace.

The crushing and grinding units are capable of handling up to 100 tons per twenty-four hours and although the present tank-capacity is 25 to 30 tons the addition of further thickeners and agitators would make an increase in tonnage a simple and comparatively inexpensive matter.

The mill machinery is all electrically driven by 440-volt motors with power supplied from a 125-k.v.a. generator driven by a 120-horse-power Vivian Diesel engine.

During the year an average of thirty men was employed; eight in the mine, thirteen at the mill on construction, seven on the surface, and two salaried officials.

Cariboo Yankee Belle Mining Co., Ltd.—W. F. Cameron, manager; C. R. Cameron, foreman. The main development tunnel, planned to intersect the Corban series of quartz veins at a depth of approximately 700 feet, was advanced to 1,643 feet from the portal before operations ceased for the year.

Marriner Group.—L. H. Hinton, engineer in charge. The N. A. Timmins Corporation took an option on this property during 1938 and did considerable exploratory work in the form of deep trenches and open-cuts. It is understood that the option was relinquished.

Golden Ore Syndicate.—Forbes A. Clarke, general manager. At the time of inspection, three men were employed in driving two short adits.

*Bell-Holm Group.**—Alfred Holmwood, of Prince George, during the year unwatered a shaft sunk a number of years ago to explore some intersecting quartz veins of maximum width 3 feet contained in schistose greenstone. The property is near the north end of the boundary-line between Pre-emption Lots 1602 and 1601, and is reached by following the Prince George–Hazelton Road south-westward for a distance of 6½ miles, at which point a wagon-road 3½ miles in length leads to the property. Sampling disclosed material gold values at one point.

BY

CHARLES GRAHAM.

Zymoetz River District.

Some prospecting was done in the *Zymoetz* and *Big Bull* groups and small shipments made from each to the sampling plant at Prince Rupert.

Usk District.

Small shipments were made from the *Cordillera* and *Lucky Luke* to the sampling plant.

A lease has been given on the *Columario Mine* to W. Duncan, of Usk, who expects to commence work early in the year.

Pitman District.

Grotto Group.—Considerable prospecting has been done and several shipments made to the sampling plant. Work is being continued through the winter months. This property is about 6 miles east of Usk.

* By Douglas Lay.

Hazelton District.

Silver Standard Mine.—Canadian Cadillac Gold Mines, Limited. A. S. Williamson, manager. This property, from which considerable tonnage has been mined some years ago, was reopened.

Nos. 4 and 5 crosscut tunnels have been cleaned up and retimbered. They are now in good shape. These tunnels are each in about 950 feet and intersect several veins.

Ore-extraction in previous years had been on the 400 level, No. 4 adit, where considerable stoping had been done.

Some additional work was done on all veins by hand, principally for sampling purposes. No underground mining operations were carried out.

The old camp was cleaned up and the necessary repairs made to the various buildings. There is nothing definite yet with regard to a future programme.

Smithers District—Hudson Bay Mountain.

Glacier Gulch.—Campbell, Loveless & Banta continued operations on their claims and made a shipment of ore. Prospecting was also done on the *Snowshoe*, *Coronada*, *Victory*, and *Empire* groups.

Babine Mountain.

Prospecting was done on the *Valhalla*, *Rainbow*, *Driftwood*, *Victoria*, *Lorraine*, and *Silver Pick* groups.

Telkwa District—Dome Mountain.

Babine Gold Mines, Ltd.—Nothing was done on this property during the year.

Grouse Mountain.

Prospecting was done on the *D. & N.* and *Last Chance* groups.

Topley District.

Some prospecting was done on the *Gold Group*, *Golden Eagle*, and several other groups during the summer.

Aiken Lake District.

Croydon Group.—Consolidated Mining and Smelting Company of Canada, Limited. E. Brunland, superintendent.

Considerable prospecting was done during the summer, eight men were employed. Work was discontinued in September when a bush fire destroyed the camp.

MERCURY DEPOSITS.

Fort St. James District.

Mercury Group.—O. J. Ostrem, owner. Under option to Consolidated Mining and Smelting Company of Canada, Limited. Eight men under the direction of E. Brunland carried on active prospecting on this group. This is being continued during the winter months.

ANTIMONY DEPOSITS.

Snowshoe Group.—O. J. Ostrem, owner. Some prospecting has been carried on by the owner on this group.

TUNGSTEN DEPOSITS.

BY

J. A. MITCHELL.

Hardscrabble Mine.—Columbia Tungstens Company, Limited. A. E. Pike, manager; D. D. Fraser, consulting engineer. During the early part of the year, underground development was carried on with a skeleton crew of fifteen men. In May the power-house, pilot-mill, and adjoining buildings were completely destroyed by fire.

Underground work was suspended and rebuilding was commenced during the summer with the erection of a power-house 24 by 42 feet. The plant installed consists of a 120-horse-power Ruston Diesel to drive a 100-k.v.a. General Electric generator, and a 60-horse-

power Ruston to drive a Holman 312-cubic-feet compressor. Starting equipment and a small auxiliary lighting plant were also installed.

A new frame structure bunk-house, 24 by 56 feet, was built and a new office building erected. All buildings were wired and connected to water-mains.

An electric hoist is being installed and is being equipped with safety devices as required by law.

Because of suspended operations during the rebuilding period, underground development was light and consisted of only 80 feet of sinking, 166 feet of crosscutting, and 255 feet of drifting, a small part of which was in the overburden.

PLACER OPERATIONS.

BY

J. A. MITCHELL.

(N.B.—A general shortage of water curtailed the production of placer gold during 1938.)

Cariboo Area.

Consolidated Gold Alluvials of B.C., Ltd.—A. M. Richmond, general manager; E. E. Mason, general superintendent; J. K. Halley, mine engineer. This company operates the *Wingdam* mine at Wingdam; workings are known as the *Sanderson* and *Melvin* mines.

The *Sanderson* mine-workings are in inter-Glacial gravel at an elevation of 2,960 feet. Access to them is by one vertical and one incline shaft, both driven in gravel. The pillar-and-stall method of mining is used, with close timbering. The workings now cover an area of 20 acres. Haulage is by means of a storage-battery locomotive. About ninety men are employed. During the year 52,435 cubic yards of gravel was extracted, yielding 7,046 fine ounces of gold.

The *Melvin* workings were projected to mine the narrow, deep channel of Lightning Creek. They consist of a drainage and service level in rock at 2,800 feet elevation, and drives in the deep channel at 2,875 feet elevation, connected to the former by raises and sub-levels in rock. Entry is had by a 270-foot shaft sunk in rock. During the year, three entries were made into the deep channel and 224 linear feet of reef drives and 1,050 feet of gravel drives were completed. These workings were flooded by the waters of Lightning Creek on March 22nd, 1938. Since that date no further work has been done.

Conditions at the *Sanderson* mine are entirely different; there are no bodies of slum to contend with and the gravels are thoroughly drained. Provided experienced men are in charge these gravels can be safely worked without difficulty.

The *Sanderson* workings are separated from the *Melvin* workings by an 18-inch reinforced concrete bulkhead at the top of the connecting raise. The level of the water in the *Melvin* workings is kept below this bulkhead by the use of a 500-gallon-per-minute Pomona pump located at the collar of the *Melvin* shaft. This is capable of handling the flow but a 1,000-gallon-per-minute Johnson pump is in reserve for emergency use.

Hixon-Quesnelle Placers, Ltd.—Brian Briscoe, managing director; A. C. Stewart, superintendent. Fourteen men and a No. 6 monitor under 126 lb. pressure were employed at this operation at the time it was inspected.

Quesnel Mining Company, Ltd.—Chas. S. Buck, superintendent. An average of thirty-five men was employed at this operation during the summer.

Deriving water from Spanish Creek, this company has opened up a hydraulic pit on the Cariboo River, on the *Ruby* lease, down-stream from Spanish Creek, proving the existence of a former channel of the river lying buried instream in the south bank of the latter. The bed-rock is about 25 feet above the river. So far as is known, this is the only hydraulic that experienced no water-shortage during the year, the supply being adequate for the continuous operation of one 8-inch and one 7-inch nozzle throughout the season.

Placer Engineers, Ltd.—Ernest F. Lang, manager. It is reported that twelve men and and one monitor were employed at this operation during the summer.

Bullion Placers, Ltd.—Ray F. Sharpe, general manager; J. A. Ryland, superintendent; J. Forman, mine foreman. An average of seventy-five men and two monitors were employed at this operation during the summer.

The abnormally dry season resulted in an unavoidable curtailment of yardage-output, and at the latter part of the season probably would not exceed 1,250,000 yards. The wisdom of the campaign of Keystone-drilling carried out in recent years has been demonstrated, as it has been of a particularly informative character, revealing unexpected features, and enabling future operations to be planned with certainty. The *Bullion* pit has now holed through to the upper part of the *South Fork* pit.

Pine Creek Mining Co., Ltd.—There were ten to twelve men and one monitor employed during the year.

Burrard Placers, Ltd.—There were ten to twelve men and one monitor employed at this operation during the year.

Sangdang Placers.—Wm. H. Hong, general manager. A No. 5 and No. 2 monitor under 60 lb. pressure and an average of fifteen men were employed at this operation. As was general throughout the area, the lack of water seriously curtailed the production. The banks are up to 80 feet high.

Last Chance Placers.—Wm. Hong, manager. One No. 3 monitor, working under a 100-foot head of water, and three men were employed at this operation. The banks are up to 70 feet high.

Montgomery Creek Placers.—Wm. Hong, manager. One No. 1 monitor, working under a 100-foot head of water, and three men were employed at this operation. The banks are up to 60 feet high.

The Ketch Mine.—Russel McDougall, superintendent. One No. 4 monitor, working under a pressure of 70 lb., and an average of fifteen men were employed at this property.

Dragon Creek Placers.—Russel McDougall, manager; D. Smith, foreman. One No. 2 monitor, working under a 40-lb. pressure, and a maximum of five men were employed at this operation.

Eastman Red Gulch Placers, Ltd.—A. F. Eastman, general superintendent. One monitor and seven men were employed during 1938.

French Creek Hydraulic Placers, Ltd.—Ivan I. Felker, superintendent. This placer is worked by one monitor at 120 lb. pressure and eight men are employed.

Barkerville Gold Mines, Ltd.—C. A. McPherson, superintendent. Work at this placer was confined to construction-work and ditch-making. Nine men were employed.

Slade Placers, Ltd.—Maury Caldwell, superintendent. This placer was worked by one No. 2 monitor until the water-supply failed. Work was then confined to construction-work. Three dams were built and the ground is in good shape for next year's operation. Six men are employed.

McMillan Leases.—Fraser & Peers, of Quesnel, B.C., acting for Portland interests, drilled seventeen holes and put down nineteen shallow shafts preparatory to further drilling. This work ceased when the option was relinquished.

No Name Placer Mine.—Operating for the same account as on the McMillan property, Fraser & Peers, employing a crew of three men, put down four shafts to bed-rock on this ground.

A new discovery of coarse gold was made during the year by D. Pearson on a small creek locally named No Name Creek, flowing north-eastward and eastward into Beaverpass Creek, north of the mouth of Baldhead Creek. The property is about 3½ miles, by the Beaver Pass trail, from Beaver Pass House. By sinking in old Chinese workings, which followed post-Glacial gravels down to a false bed-rock of boulder-clay, the owner discovered coarse gold on true bed-rock only a few feet below the clay. The total recovery to date from ground-sluicing operations is reported as being very encouraging, including one nugget weighing 18 dwt. The continuation of operations will doubtless reveal the full significance of this discovery, which is not now clear from exposures, beyond the fact that it is of undoubted merit.

Gagen Creek.—Still for the same account, Fraser & Peers, with a crew of men, are drilling and sinking a shaft on the leases owned by H. G. Jamieson.

Lowhee Mining Co., Ltd.—Chas. W. Lea, general manager; Henry Lea, manager; Joseph House, superintendent. At the time of inspection two No. 6 monitors were at work under 65 lb. pressure per square inch. There were twenty-seven men at work, but the average number of men employed during the 1938 season is reported to be about fifteen.

The effect of the dry season was severely felt at this property, at which hydraulic operations have now been carried on for *forty years*, the hydraulic pit and sluice-flume now reach a length of 1⅓ miles.

BY

DOUGLAS LAY.

Cariboo Placers, Inc.—This company, a Seattle incorporation, holds fourteen leases on the right bank of Antler Creek, adjoining and down-stream from the property of Guyet Placers, Limited. There is every topographic indication that a former channel of Antler Creek, some miles in length, lies buried in its right bank at a height of about 260 feet above the creek. Investigation seems warranted to determine if dredging or hydraulic possibilities exist.

Devil's Canyon.—A new discovery was made during the year by R. R. Moffat, immediately east of Devil's Canyon, on the Quesnel–Barkerville Road. At this point, there is a considerable amount of meadow-land at the Chisholm Creek-Devil's Lake Creek divide on both sides of the latter. Early miners worked off post-Glacial deposits situated on top of the east wall of Devil's Canyon. The new discovery was made at the north end of a meadow considerably farther instream. A small hydraulic plant was installed by the owner, water for the purpose being pumped from one of the small lakes in Devil's Canyon.

Canamco, Ltd.—This company, of which E. B. Skeels is president, for some weeks operated a drag-line plant of modern design on a large bench on the left bank of the Fraser River, on Pre-emption Lot 502, 5½ miles north of Quesnel, after which the plant was moved to Canyon Creek. This installation, of movable land-plant type, consists of a digging unit comprising a boom drag-line caterpillar shovel with 1-cubic-yard bucket capacity operated by a gasoline-engine, and a recovery plant mounted on caterpillar tracks, operated by a Diesel-electric unit. The recovery plant comprises receiving hopper; double-screen trommel (holes 1 inch round and ¼ by 1 inch slotted); four 36-inch Ainlay centrifugal bowls with rubber riffles, for recovering gold, taking trommel undersize; sand-pump which stacks the tailings from the Ainlay bowls; and coarse tailings stacker. In this case wash-water was pumped from the river by a Jaeger self-priming centrifugal pump. The capacity of this plant is about 75 cubic yards per hour and four men per shift are required for its operation.

Property of D. B. Wallesen.—Two leases held by D. B. Wallesen on the west side of the Fraser River, in part situated on Pre-emption Lots 6170 and 82, are 5 miles by motor-road from Quesnel. Placer occurrence is typical of former river-bar deposition, now expressed in the form of elevated benches of considerable extent. Much ingenuity is reflected in the inexpensive and efficient plant devised by the owner for the recovery of gold. This comprises a mobile bucket-elevator with pulleys on 18-foot centres, delivering gravels shovelled by hand into its boot at an "A" grizzly, with bars three-quarters of an inch apart, the undersize passes to a blanket-table covered with expanded metal riffling, 7 feet long, inclined at a slope of 3 inches in 12 inches. The total power required for the operation of this plant is 4½ horse-power, which includes the power required (3 horse-power) to pump sluice-water from the Fraser River. The total consumption of gasoline per shift is 4 gallons, and three men suffice for the operation of this plant, which has a capacity of upwards of 20 cubic yards per shift.

Operations of A. P. Himmelman.—A considerable yardage was mined by drag-line installed by A. P. Himmelman on Placer-mining Lease 3150, situated on Pre-emption Lot 716, on the left bank of the Fraser River, between Chimney and Pablo Creeks, and distant 14 miles from Williams Lake by highway and branch motor-road. At this point a bench approximately 100 feet above the river, of considerable extent, offers excellent dump facilities. Extensive old workings at the up-stream end of the bench indicate that this was formerly a favourable point for deposition of gold. During the year gravels were mined to a maximum depth of 35 feet, which suggests a possible underlying former channel of the river in this region.

Cottonwood Canyon Gold Mines.—The leases of H. Bellos and associates on the Cottonwood River, described on page C 25, Annual Report, Minister of Mines, British Columbia, 1936, have been acquired by a syndicate named Cottonwood Canyon Gold Mines. A small hydraulic installation utilizing water from Hush (May) Lake was completed during the year,

giving a head of about 200 feet at the monitor, set up on a rock bench on the right bank of the river, about 45 feet above the latter, where dump facilities for tailings are good.

Leases of J. Coreau.—J. Coreau, of Cottonwood, holds two leases on Norton and Mary Creeks, tributaries of John Boyd Creek. The property is reached by a wagon-road 5 miles in length, which branches from the Quesnel–Barkerville Road at Cottonwood. One lease on Norton Creek covers the old *San Juan* mine, reopened a few years ago under the direction of H. McN. Fraser, but subsequently again closed down after considerable work. The present owner reports encouraging values in gravels overlying a rock bench about 2,000 feet in length and somewhat under 200 feet in width on the right bank of Norton Creek.

Manson Creek District.

BY

CHARLES GRAHAM.

Lost Creek.

Dunsmore Gold Mining Co., Ltd.—J. M. Dunsmore, manager. This is an underground operation, the only one in the district. There is a shaft 90 feet deep on the East Bench of Lost Creek. The shaft is connected to an old adit-level driven over twenty years ago which serves as drainage and provides a second opening. Water for sluicing is pumped to the shaft by a 450-gallon centrifugal pump. A camp has been built.

Lost Creek Placer Gold, Ltd.—Bert McDonald, manager. This is a surface operation using a combination shovel and drag-line. Water is very scarce, not being sufficient to provide for sluicing. They have started to build a ditch to bring water from Manson Creek.

Manson Creek.

The *Northern Gold Placers* had a steam-shovel operating last year, but have apparently suspended operations. There are several individual operators working on the creek.

Slate Creek.

Consolidated Mining and Smelting Company of Canada, Ltd.—W. M. Ogilvie, manager. This is a drag-line operation working three shifts and employing thirty-five men. A bulldozer is used to break the ground into the drag-line pit.

Germansen Creek Area.

Germansen Ventures, Ltd.—Frank deGanahl, manager. This is a hydraulic operation. Three pits have been opened up, but only two of them are being operated. A ditch and flume 11 miles in length was constructed during the winter to bring water from Germansen Lake. The ditch has a capacity of 200 second-feet. A slide took out about 250 feet of flume which caused considerable delay in the early part of the season. A flume section had to be built in around the slide. The company completed a road from their camp on the Omineca River about 8 miles up Germansen Creek, built a bridge across the creek and connected the road with the road built by the Consolidated Mining and Smelting Company of Canada, Limited, from Germansen Lake to Slate Creek, thus giving a road through from Fort St. James to Germansen Landing on the Omineca River. Supplies can now be taken in by truck.

Germansen Mines, Ltd.—A. A. McCorkell, manager. This is a hydraulic operation on Germansen Creek employing about ten men.

Takla Lake District.

Tom Creek.

Tom Creek Placer Mining Co.—J. J. Warren, manager. This is a surface operation using a steam-shovel. About twenty-two men are employed.

Harrison Creek.

Harrison Creek Ventures, Ltd.—Frank deGanahl, manager. The property did not operate during the year, the gravel from the previous winter's underground work was sluiced.

Vital Creek.

Northern Ventures, Ltd.—Frank deGanahl, manager. This is the only underground operation in the district. It did not operate during the year.

Quartz Creek.

Several groups of prospectors worked on this creek during the season.