PART D

ANNUAL REPORT

OF THE

MINISTER OF MINES

OF THE PROVINCE OF

BRITISH COLUMBIA

FOR THE

YEAR ENDED 31ST DECEMBER

1938

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1939.

BRITISH COLUMBIA DEPARTMENT OF MINES.

VICTORIA, B.C.

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

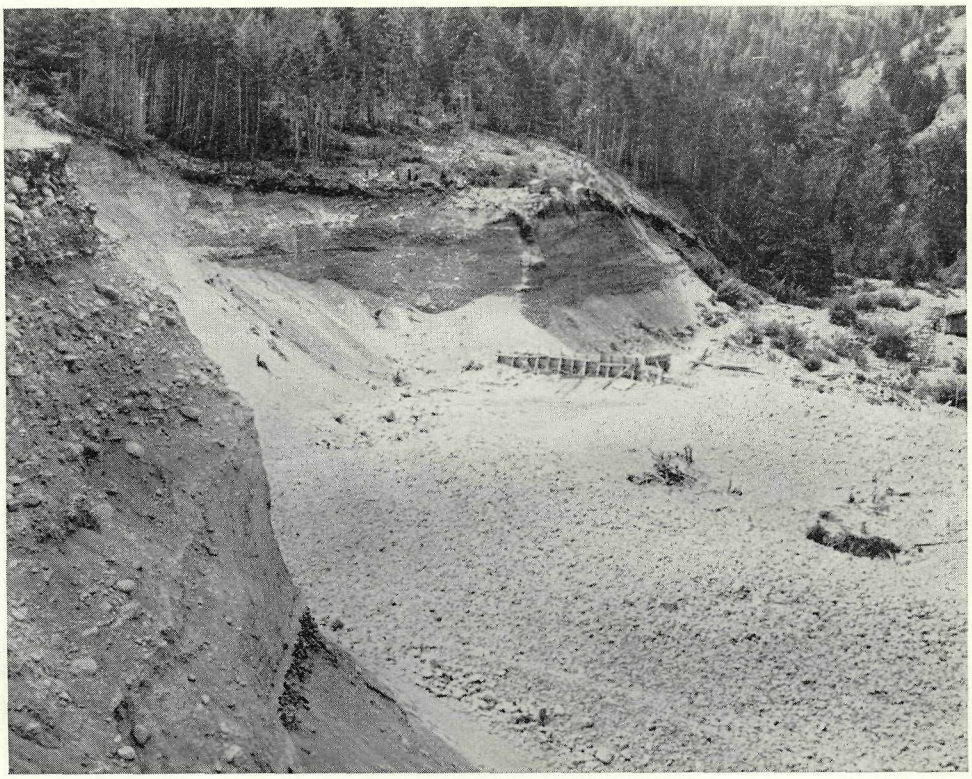
JOHN F. WALKER, *Deputy Minister.*

JAMES DICKSON, *Chief Inspector of Mines.*

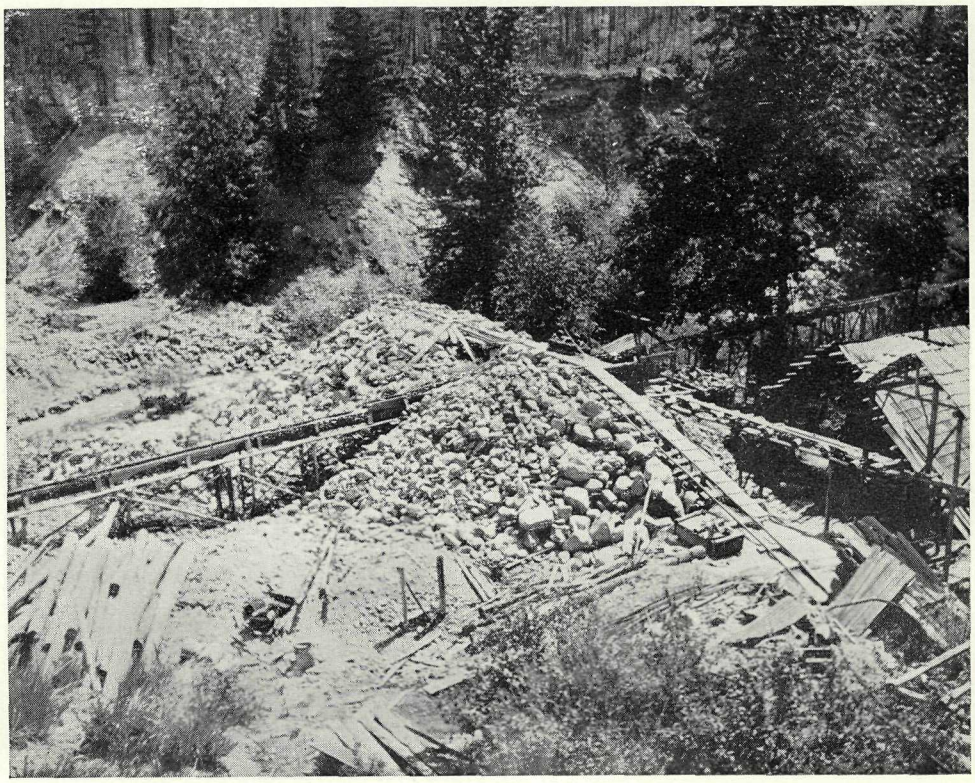
D. E. WHITTAKER, *Provincial Analyst and Assayer.*

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

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



Lower Rock Creek. Stratified gravel above rock bench.



Upper Jolly Creek. Incline track from drift workings.

Headwaters of Azure River (left) and Raush River (right), looking north-west.

Looking down Hobson Creek Valley from Blue Ice property. Claim post is in right foreground at edge of glacier.

PART D.

SOUTH-CENTRAL DISTRICT.

BY

M. S. HEDLEY.

GENERAL SUMMARY.

Capacity operation by the Granby Company was responsible for a greatly enlarged metal output for the South-Central District. Gold production from other sources was also greater than in 1937, owing to aggressive development by the operating companies and to activity by lessees.

Hedley Mascot Gold Mines, Limited, explored by means of a new lower adit totally new ground indicated by diamond-drilling. Kelowna Exploration Company, Limited, increased production, and Canty Gold Mines (Hedley), Limited (N.P.L.), pressed development from the completed 450-foot shaft.

Several large companies took an active part in the search for new mines and Anglo-Huronian, Limited, optioned the *Blue Ice* group on Hobson Creek.

In the Beaverdell Camp development by the Sally Mines, Limited, was disappointing, but Highland Bell, Limited, has shown that the ore is not limited by depth. Beaverdell-Wellington Syndicate investigated ore possibilities on the *Bounty*, *Duncan*, and other claims.

Throughout the southern and central parts of the district it is very gratifying to see many individuals and groups, chiefly from the Boundary country and Rossland, engaged in leasing old properties. These men deserve a great deal of credit and are of great value to the country. Among such may be mentioned those busy at the properties of Dentonia Mines, Limited, and Kalamalka Gold Mines, Limited, in the Kettle River and Twin Lakes areas; and on the *Copper King* (Kamloops) claim, and others. These men create money and employment, and maintain or rekindle interest in many camps on ground not sufficiently attractive at the present time to be taken up by the larger operating companies.

On the other hand, prospecting has fallen off. Although a good deal of the district has been combed, there are still areas which have received little attention. In areas where a new discovery has been made, or where there is revival of an old camp, numbers of experienced prospectors materialize, but there are few who go to the trouble and expense of searching in new fields.

LODE-GOLD DEPOSITS.

AZURE RIVER-HOBSON CREEK AREA.

References.—Annual Reports of the Minister of Mines, British Columbia, 1923, 1927, 1929, 1933; J. R. Marshall, Geological Survey, Canada, Summary Report, 1927, Part A; N. F. G. Davis, Geological Survey, Canada, Summary Report, 1929, Part A.

Introduction.—This area is in the north-west corner of Kamloops Mining Division, in a mountainous region at the headwaters of Hobson Creek and of Azure and Raush Rivers. The mountains are part of a system which has no definite name, but they are doubtless a south-eastern continuation of the Cariboo Mountains; they extend south-eastward to the north-south valley occupied by North Thompson River, east of which are the Columbia Mountains.

Drainage from the area is south by Azure River and west by Hobson Creek. These streams flow into Clearwater Lake, which is drained by Clearwater River into the North Thompson River. Drainage to the north is by Raush River, which flows into the Fraser near McBride, some 40 miles distant. The headwaters of the North Thompson River lie a few miles to the east.

There are three natural routes into the area: First, by way of the North Thompson River from Gosnell on the Canadian National Railway, a distance of 45 miles; second, 16 miles by trail up Hobson Creek from the head of Hobson Lake; the third route, over which there has been no travel for years, is up the valley of the Raush River to its headwaters, a distance of about 50 miles.

The trail up the North Thompson River is 45 miles in length from Gosnell to the *Summit* group. It is poorly located, although quite passable. From Gosnell, at an elevation of 2,500 feet, the trail follows the bottom of the North Thompson River Valley for a distance of 30½ miles. The first 20 miles of the route is through heavy stands of cedar and spruce and, after climbing over a ridge on the mountain-side near Thunder River, the upper section follows less heavily timbered and partly meadow-land. Many mud-holes in the trail make going heavy in wet weather.

The river is forded at an elevation of 3,450 feet, a crossing difficult or impossible at high water. The trail then climbs in 3 miles to Summit Lake, elevation 5,200 feet, past which it drops gradually for 2½ miles through an open pass and then steeply for 1½ miles into Azure River Valley, elevation 4,350 feet. The valley-bottom is followed for 4 miles through spruce and balsam woods, open meadows, and some rocky hillsides to an elevation of 4,800 feet, at which point a branch leads to the *Summit* group. The trail continues up the Azure River for some 4 miles, where, at the north end of open meadows, it drops rapidly into the deep valley of the main Raush River.

The main cabin on the *Summit* group is at an elevation of 5,335 feet, nearly a mile from the river. Above the cabin the trail follows above timber-line through an open pass leading to Hobson Creek, at the west end of which is a second cabin. There is no trail down this branch of Hobson Creek. Above the second cabin a trail leads steeply up a talus-covered hillside, attains an elevation of about 7,000 feet, and drops down on the southern part of the *Blue Ice* property. The trip from Gosnell to the *Blue Ice* usually takes four days with lightly-loaded pack-horses, and the *Summit* group can be reached in three fairly heavy days.

The trail between Gosnell and Azure River has never been properly located and is merely an outgrowth of the original trapper's trail. Relocation, notably at Leos Creek, Thunder Basin, and Pass Creek, would doubtless make for a shorter, much easier trail, but there are great obstacles to be overcome in road-construction, owing principally to the wetness of the climate and also to the high pass at Summit Lake.

The writer has no direct knowledge of the Raush River route, but it is known to be, in its lower stretches, one of gravel footing in a relatively dry terrain. A trail, approximately 50 miles in length from railroad to Azure River crossing, was built ten years ago, but there has been no travel over this route for several years. It is understood that in the upper stretches of the main Raush Valley difficulty is encountered in repeatedly crossing the powerful stream which meanders through the heavily glaciated, steep-sided valley-bottom, and that in the uppermost section the steep climb through rocky country to the headwaters of the Azure River presents considerable difficulty to road-construction.

The third route, via Hobson Creek, was built to within 1½ miles of the *Blue Ice* property in November of 1938, when further work was stopped by heavy snowfall. A pack-trail was cut out along the bottom of Hobson Creek from the lake and the climb made by easy grade above and south of that branch of the creek fed by the Blue Ice Glacier. There do not appear to be any serious obstacles in the construction of a road over this route, and it is without a doubt the most efficient means of access to the area of the *Blue Ice* property. It is reported that the trip from Hobson Lake will, upon completion of the trail, be made by pack-horses in a day. The boat trip on Quesnel Lake is 70 miles long and that on Hobson Lake 5 miles; there is a truck-road 5½ miles in length between the two lakes.

Topography and Climate.—The area lies amongst high, glacier-capped mountains which rise to elevations in excess of 8,000 feet. Few peaks in the general vicinity exceed 9,000 feet in elevation, but some rugged summits north of Raush Glacier and at the head of North Thompson River may be considerably higher. All of the higher peaks and most of the more prominent ridges bear glaciers which, as on the north part of the area and a few miles to the south, may coalesce to form extensive ice-fields.

Azure River heads in a large meadow in an open, through valley at an elevation of 5,250 feet. A branch of Raush River heads also in this meadow, from the north edge of which it falls precipitously some 2,000 feet in a distance of 3 miles to join other branches in the large, gravel-filled valley at the foot of Raush Glacier. The Raush River Valley trends north-west for a few miles and then swings to the north through less high mountains. Azure River Valley is steep-sided and is between 3,000 and 4,000 feet deep. From the headwaters to the junction with Braithwaite Creek, 10 miles to the south, there are only two open passes, that via Summit Lake to the east and that to Hobson Creek on the west.

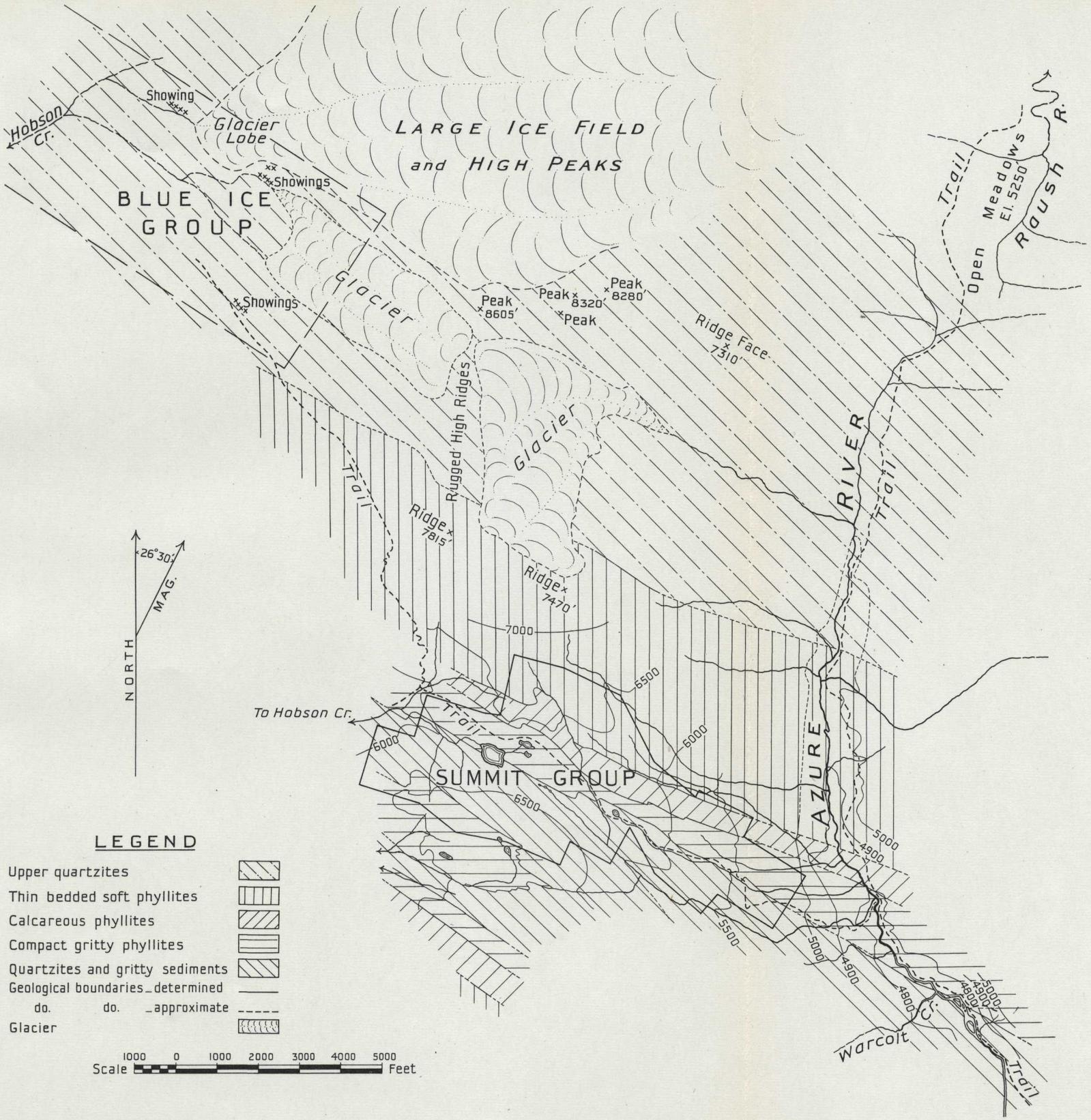


Fig. 1. Sketch-map of country at headwaters of Hobson Creek, Azure River, and Raush River.

Hobson Creek has two main branches, heading in ice-fields to the north and south of the area; two smaller branches, one joining the south branch and the other the north branch, head on the *Summit* and *Blue Ice* properties respectively. Each of these hangs above the parent branch. The names of these members of Hobson Creek are not known and existing maps throw little light, so they are here left unnamed. That branch which heads on the *Blue Ice* property is perhaps rightfully named Fredwells Creek.

The accompanying map, Fig. 1, is based on a plane-table survey of the Crown-granted *Summit* group and was extended to include a part of the Azure River (reduced from Fig. 2). Those peaks of which elevations are given are located by plane-table triangulation, and all other detail is sketched. All elevations are based on altimeter readings and are believed to be reasonably accurate.

The climate is one of heavy precipitation. It is reported that in wetter years rain may fall throughout a considerable part of the summer but that July and August are commonly clear. Marshall reports that in the field season of 1927 only the period from mid-July to late August was without much rain. In 1938 rain was falling on entry to the country on July 10th but clear, warm weather obtained from July 12th to August 1st, when rain fell daily until August 21st, after which there was fine weather until leaving, six days later. There may be, in late summers, considerable snow remaining at elevations in excess of 6,000 feet on July 1st, and snow may come to remain at the end of September. Work at higher elevations is often hampered by heavy clouds that roll in from the lakes to the west and north, and greatly obscure vision above 6,000 feet.

Timber-line proper is at an elevation of 6,000 feet. The growth includes balsam, fir, and spruce, in sizable stands locally to elevations in excess of 5,000 feet. Brush is not excessively thick in the upper parts of the valleys.

Of game, caribou, once said to be abundant, are not now plentiful. Occasional moose and some deer are reported, and goat are found in localities both north and south of the area. Grizzlies frequent the higher slopes in the autumn.

History.—The first mention of the area is in the Annual Report of the Minister of Mines for 1919, when it was stated that an Edmonton syndicate had obtained an option on the *War Colt* group and built a trail from the Canadian National Railway to the camp. In 1923 the area was visited by A. W. Davis, Resident Mining Engineer, at which time all of the present stakings had been made, and by H. G. Nicholls, who succeeded Davis, in 1927 and 1929. J. R. Marshall, of the Geological Survey of Canada surveyed the general area in 1927 and a short report was written; the results of this work and of further surveys in the general Clearwater Lake area by N. F. G. Davis was published in full by Davis in 1929. The present writer spent the months of July and August, 1938, in making examinations, the results of which form the basis of this report.

The area seems to have been first visited by trappers about the year 1913, notably by Adolph Anderson, of Albreda, B.C., who made his way from North Thompson River to the head of Azure River. The *War Colt* group was staked by Anderson and Lewis Knutson about 1914, and this seems to have been the first location, although not much work was done until 1918.

At about the same time, what is now the *Summit* group was staked by G. S. Stewart and Angus Horne, of Blue River, and in 1920 it was reported that considerable work was done on the several properties. Fred Wells staked a part of what is now the *Blue Ice* group in 1923, but did not return, and other stakings were known in this locality in the same year. Several engineers reported on the various holdings in 1926 and 1927, and in 1928 Joseph Errington, of Toronto, optioned all stakings in the area and made several new locations. Under the direction of his brother, W. Errington, a pack-trail was built from Raush Valley near McBride on the Canadian National Railway, up Raush River to Azure River, a distance of perhaps 50 miles. A trail was built from the *Summit* group to the *Blue Ice,* and a main camp was built at Azure River crossing. The options were relinquished in 1931 and the Raush River trail was abandoned. In 1933 Albreda Holding Company, Limited, a private company with head office in Vancouver, acquired the *Blue Ice* and *War Colt* groups, but apparently little work was done and the groups were allowed to lapse.

In 1934 Western Investments, Limited, acquired the holdings of Angus Horne, G. S. Stewart, and W. R. Johnson, of Blue River, formerly known as the *Summit* and *Grizzley*

groups. This property, now known as the *Summit* group, was surveyed in 1936 and Crown-granted in 1937. It was reported on by the company's engineer, Ned E. Nelson, in 1936, and was examined by Pioneer Gold Mines of B.C., Limited, in 1938. Some surface work was done in these years, and the " Stewart Tunnel " adit was advanced.

The *Blue Ice* group, owned by W. R. Johnson and associates, of Blue River, was relocated in 1938 and, as the result of an examination by A. G. Langley, of Vancouver, the group was optioned to Anglo-Huronian, Limited. A trail was constructed from Hobson Lake almost to the camp, where a cabin was built, when further work was prohibited by heavy snowfall in November. It is reported that a diamond-drill and supplies were stored at Hobson Lake in readiness for an early start on a campaign of exploration in 1939.

General Geology.—The rocks within the area are all members of the Azure River series, so named by N. F. G. Davis. This is a sedimentary series of great thickness which is believed to be Precambrian in age, partly because it is unfossiliferous and also because it is lithologically similar to the Cariboo series in Barkerville area and to the Barriere series in North Thompson Valley area.

The rocks are predominantly quartzose, in which quartz grains form a chief or important constituent. Argillite and limestone are rare. To quote Davis* " The main rock-types are quartz-pebble conglomerates, massive and schistose quartzites, quartz schist, quartz-chlorite schist, and phyllite. In the lowest exposed parts of the formation grey, green, and reddish-brown quartzites and somewhat metamorphosed quartz-pebble conglomerates or grits are the dominant types. . . . In the upper parts of the formation fine-grained schists and phyllites are dominant. . . .

" The finest-grained types are crinkled and crenulated dense phyllites, varying from dark green and black to light green and pearly white . . . Some break in thin plates along the plane of foliation and reveal crenulations on a lustrous surface. On some types only a very fine puckering or crinkling is seen. The phyllites are composed of very fine-grained quartz with considerable chlorite and some sericite."

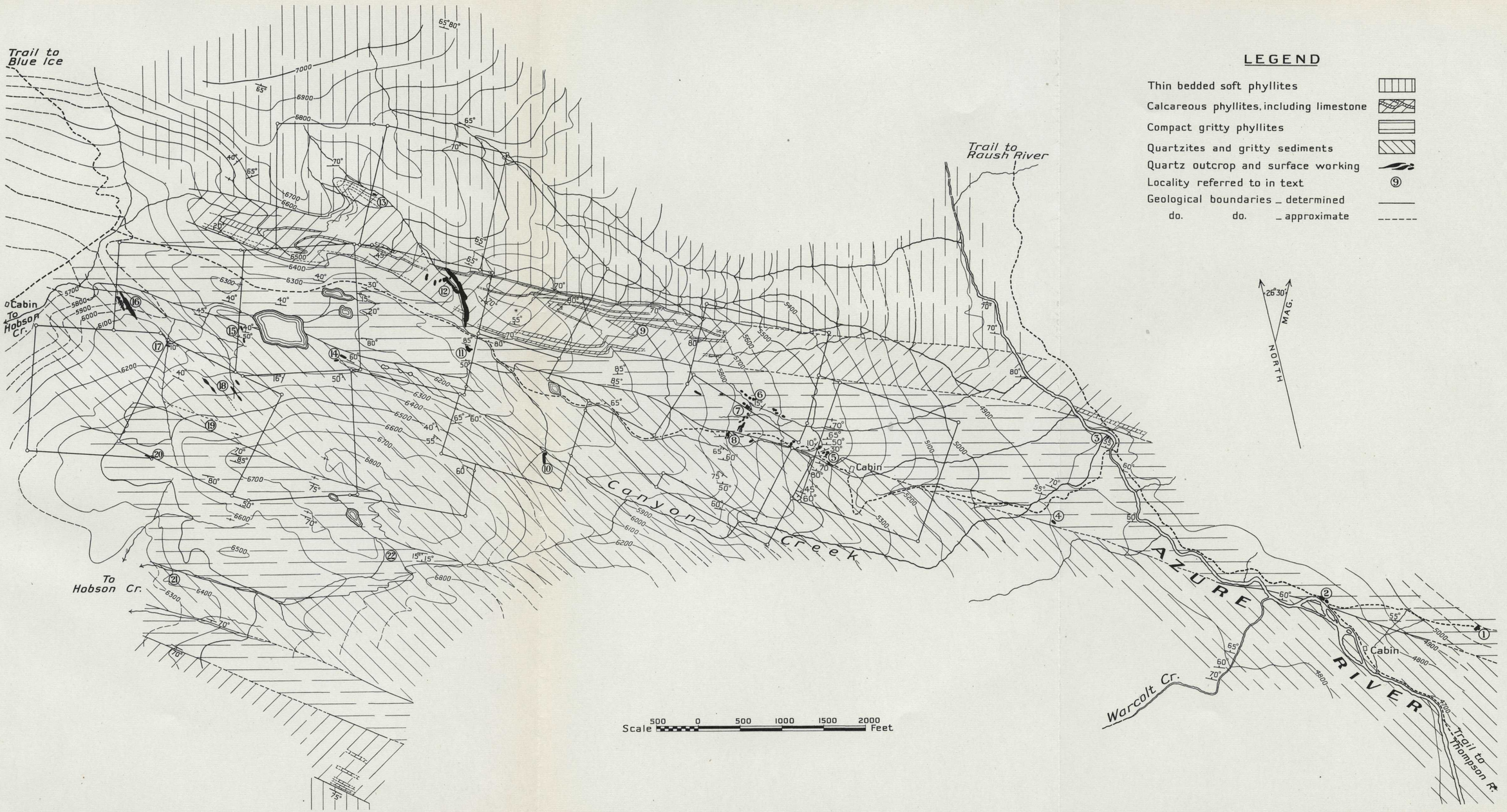
Davis has done considerable petrographic work not attempted by the writer, who prefers to lay emphasis on structure. The quartz-pebble conglomerates are rocks which contain a large proportion of quartz grains from the size of rice to, in rare cases, peas; the grains are commonly surrounded by what was originally silty material, now largely sericite. These rocks may, however, contain a matrix of fine quartz sand, in which case they may be difficult to distinguish from quartzite proper. The writer believes that no misunderstanding will arise if all of these quartzose rocks showing plainly visible quartz grains are collectively referred to as quartzites.

All of the rock-types above enumerated by Davis may be found to alternate and intergrade, and all may vary in degree of fissility or schistosity with their structural location. To be more precise, any given bed may be seen to vary in this respect whether it is involved in the limb or apex of a fold or whether or not it is caught up in a zone of minor, complex contortion.

There is to the south a body of granodiorite: a medium-grained, grey rock containing abundant quartz and biotite. It occupies a lake basin at the head of Braithwaite Creek and extends to the ridge summit about 1½ miles south of the *Summit* group. This body was not mapped, but it appears to be about half a mile wide and some 3 miles long, in a north–south direction, and is last seen as a dyke-like continuation to the south at a high elevation above and east of Braithwaite Creek. In the lake basin, dykes of the same rock but finer in texture are common, but there is very little evidence of contact metamorphism. The granodiorite is presumed to be Mesozoic in age.

The Azure River series, where closely studied by the writer on and adjacent to claims of the *Summit* group, has been subdivided into four members. These comprise: (1) Lower " quartzites " including quartzites proper, quartz-pebble conglomerates, and gritty to arkosic rocks, together with interbands of phyllite and schist. These are exposed in the crest of a major anticline and grade upwards into (2) fine gritty phyllites with rare interbeds of quartzite. These are compact, strongly-bedded rocks with a flaggy cleavage. (3) Above, is a calcareous member including phyllite, calcareous phyllite, and four or five major bands of limestone from 5 to 30 feet in thickness. This horizon is reported by Davis to be traceable to

* Geological Survey, Canada, Summary Report, 1929, Part A, pp. 286–7.



LEGEND

- Thin bedded soft phyllites
- Calcareous phyllites, including limestone
- Compact gritty phyllites
- Quartzites and gritty sediments
- Quartz outcrop and surface working
- Locality referred to in text ⑨
- Geological boundaries _ determined
- do. do. _ approximate

Fig. 2. Geological map of part of Hobson Creek-Azure River Divide, showing Summit group and location of former War Colt group.

the summit of the ridge north-west of Summit Creek. (4) An upper phyllite member is of soft, thinly-bedded and highly-cleavable rocks which verge locally on chlorite- and sericite-schists. They are characterized by lustrous, crinkled cleavage surfaces, and produce abundant fine, glistening talus.

Above this last member is a tremendous thickness of quartzites displaying all of the varieties named above. No attempt has been made to subdivide these upper quartzites because of the time involved, and it is doubtful whether subdivision of an order comparable to the foregoing is worth while. Above this large member is an upper phyllitic to schistose member seen both east and west of the north end of Azure River meadows. These last rocks make up the summits at the head of Raush and North Thompson Rivers and produce reddish and brownish-coloured bluffs and talus-slopes. They are fine-grained, glistening, and crenulated micaceous rocks which, when closely folded, form intricate structures.

Thicknesses are difficult to determine owing to folding, but rough estimates may be made. Of the lower quartzites, several hundreds of feet are exposed in the anticline which extends down Azure River Valley to Summit Creek, and the member is many times this thickness. The lower gritty phyllites are between 250 and 400 feet thick. The calcareous phyllites are about 300 feet thick. The upper phyllites are between 2,000 and 3,000 feet thick. The upper quartzites are in the neighbourhood of 5,000 feet thick. The uppermost phyllites are at least 1,000 feet thick. The rocks exposed between Summit Lake and the headwaters of Raush River and of Hobson Creek represent a stratigraphic thickness of at least 10,000 feet.

Structure.—The rocks have a regional strike of north 60 degrees west, and major folding into broad anticlines and synclines has occurred along this direction. The axis of one such major anticline extends from the summit immediately south of Azure-Hobson pass (*see* Fig. 2) to about the mouth of Summit Creek on Azure River; the fold plunges to the north-west at a low angle (10 to 15 degrees). Another major complex fold passes through the large ice-field at the head of Azure River. The upper quartzites dip steeply to the north-east and are locally overturned immediately north-east of the *Blue Ice* horizon; they are involved in a broad zone of intense contortion in the summits west of the large meadow, and a zone of more normal, synclinal folding in the summits on the east. Abreast of the north end of the meadow dips are again to the north-east, and the quartzites are seen to be overlain by the uppermost phyllitic rocks. The uppermost rocks are believed to flatten in dip farther to the north-east, about the headwaters of Raush River.

This double axis of major folding which passes through the summits about Azure River meadows is clearly seen to extend down the valley of the North Thompson River, in that section above the main trail crossing. Complicated structures along this axis are indicated in high summits to the north-west of the area, in the direction of the east arm of Quesnel Lake.

Fairly detailed study was made of the first major anticline on Azure-Hobson pass, where mineral deposits of the *Summit* group are seen to be clearly related to structure. There, in a well-exposed region of diversified rock-types and accompanying mineralization, is ample opportunity for study of benefit to one working in the area.

In the main, this anticline is seen to be a uniform structure, with its axial plane nearly vertical and with a plunge of about 15 degrees to the north-west; considerable drag-folding has occurred on the limbs near the crest of the fold, in phyllites and also in the uppermost bed of quartzite. The top of the folded quartzite is, in the area mapped, largely covered by a thin blanket of phyllites only in part eroded away. This blanket is caught into a series of numerous minor folds and plications, as at (21), Fig. 2, and casual inspection leads to the impression that the rocks are all steeply dipping, whereas the average dip is quite flat. In the zone of drag-folding as mapped, the individual folds are seen to be irregular and rather discontinuous, owing partly to the fact that they cross rocks of varying character and competency at an oblique angle.

On the north side of the pass the upper, soft phyllites dip steeply (65 to 70 degrees) north-eastward, but a pronounced flattening is seen on the ridge summit 7,815 feet elevation (Fig. 1); the dip there is 35 degrees north-eastward and again steepens farther to the north-east. The dip becomes even steeper (75 to 85 degrees) in the upper quartzite members.

Cleavage is a prominent feature in all rocks but the more massive quartzites. It has a regional trend parallel to the axis of the main folding, and tends to parallel the bedding in

major limbs at some distance from a crest. Consequently, and directly in accordance with theoretical principles, the angular relation between bedding and cleavage ranges from 0 to 90 degrees, and care must at all times be taken to distinguish between cleavage and bedding in a folded area of easily cleavable rocks.

The upper quartzites maintain a very uniform attitude until involved in the next zone of major folding. This folding is synclinal and open, east of the Azure River meadows and to the south-east into North Thompson River drainage basin, but is complex to the north-west. Major contortion is evident on the west side of the meadows, and this zone of contortion is believed to extend to the north-west beneath the ice-field and to continue beyond the head of Hobson Creek.

In the high peaks shown on Fig. 1 abnormal changes in dip may be seen from a distance, and the limestone horizon at the *Blue Ice* was not found to cross the Azure River. A fault is indicated immediately south of the 8,605-foot peak and, although presence of fresh snow on the peaks and lack of time prevented full examination, the writer believes that at this point there is a major fault which must nearly coincide in strike with the formation. Demonstration of the existence of this fault, and determination of its character and extent, is of importance in a mineralized region.

Economic Geology.—Mineralization consists of pyritic deposits containing gold and small amounts of silver. Except for limestone replacement on the *Blue Ice* all mineralization is in quartz-filled fractures. Pyrite is by far the most abundant mineral, but there are also small and variable amounts of galena, sphalerite, chalcopyrite, tetrahedrite, and arsenopyrite. A light-coloured carbonate, which becomes dark on weathering, is a common accompaniment of the quartz; it is siderite, and possibly in part ankerite. So far as is known, the gold is finely divided and free gold is not obtained on panning.

Quartz veins are very common throughout the area and range in size from stringers and gashes to veins 30 and more feet wide. None appears to be very continuous, and individual veins, regardless of width, are no more than several hundred feet long. There are, however, zones of considerable length along which quartz veins are localized as individual bodies or as fracture systems. One such zone follows the north-eastern flank of the southern major anticline at or near the contact of the quartzites with overlying phyllites. Another broad zone passes through the *Blue Ice* property, through the high peaks south-east of that ground, and becomes less prominent past the Azure River. This zone is within the upper quartzites where they are uniformly steeply-dipping, but it seems definitely related to the near-by major zone of contortion and perhaps also to the postulated fault.

In general, the greatest amount of quartz and the most uniform and continuous bodies occur in the quartzites and quartzitic rocks, whereas veins in the softer phyllites tend to occur as irregular kidneys or lenses. In the uppermost phyllites abreast of the meadows there is considerable glassy, crystalline quartz, in widths up to 8 or 10 feet, but with little continuity. The veins are, with rare exceptions, fillings of fractures with little or no shearing, and most of the walls are tightly frozen.

Limestone replacement is, as far as known, restricted to one band 20 feet wide, within quartzites, on the *Blue Ice* property. The several limestone-bands above the main anticline are nowhere seen to be replaced by sulphide, although there is some quartz veining, as at (9) in Fig. 2, and locally a little silicification. Another prominent limestone-band 25 feet wide, 400 feet below the lower contact of the upper quartzites, is similar in this respect.

Summit Group. This group of sixteen Crown-granted claims and fractions is owned by Western Investments, Limited, 543 Granville Street, Vancouver, B.C.; C. W. Bradley, president. It occupies the open pass between Azure River and Hobson Creek, and lies above timber-line except for the south-eastern end. There is trail connection with the Azure River and the *Blue Ice* property.

The pass is open and grass-covered and all parts of the ground are easily accessible, except for a few bluffs on the south side which are fairly difficult to climb; the elevation ranges between 5,000 and 6,800 feet. There are two small cabins; one near the south-eastern end, elevation 5,335 feet, and one just north-west of the property, elevation 5,600 feet.

The mineral-deposits are all quartz-filled fissures containing pyrite, accompanied locally by galena, chalcopyrite, sphalerite, and rare amounts of tetrahedrite and arsenopyrite.

The general geology has already been discussed, at which time it was pointed out that this ground is on the crest and north-east limb of a major anticline which plunges at a low angle to the north-west. The lowest rocks exposed are quartzites, partly roofed over on the crest of the anticline by gritty, competent phyllites possessing a flaggy cleavage. Above is a phyllite member including many calcareous beds and several distinct bands of grey limestone, from 5 to 30 feet thick, not all of which are continuous. Above is a succession of thin-bedded and strongly fissile, soft phyllites which weather to produce many thin, glistening, crenulated cleavage-plates.

There are many drag-folds in these rocks, most of which are irregular, rather discontinuous, and tend to die out in the uppermost phyllites. The lowest phyllites are intricately crumpled in a thin blanket over the quartzites, and in the centre of the pass several of the drag-folds are seen to be complex zones of crumpling, being drags in general form only. In the quartzites the folds are more uniform, but there are some with quite sharp and partly broken crests. Cleavage is prominent in all but the more massive quartzites and is most strongly developed where the folding is most intense. Locally, some of the rock must lithologically be classified as schist but, since it is of local occurrence and directly produced by dynamic forces which have caused rock-flowage, it is best considered merely as an extreme variety of phyllite.

Fig. 2 shows all essential geology and the location of the principal drag-folds, as marked by hooks in the geological boundaries. Faulting is rare, but between localities (19) and (20) a fault which trends north 80 degrees east is seen to displace the rocks about 150 feet. There appears also to have been some faulting along the line of the " Stewart " vein, locality (12), but the displacement is not marked and the fault fades out along its strike.

The quartz veins and masses, all the important ones of which are mapped accurately and designated by number, occur near the north-easterly contact of the quartzites, and are further localized by drag-folds.

The quartz veins all dip steeply and tend to strike in four principal directions. One set of veins parallels the general structure, an average strike of north 60 degrees west. Other sets strike north 20 to 30 degrees west, north, and north 30 to 40 degrees east, or roughly at right angles to the regional strike. This is more a general than particular rule, from which there are many divergencies. Those veins which are in quartzites have many branches which tend to leave the parent in one or more sets and play out at distances from a few inches to 50 feet. Some individual quartzite beds or bands have been shattered and contain a ramifying maze of frozen stringers which are, in such cases, nearly always barren of sulphide. Those veins parallel to the formation tend to be narrow and are generallly unmineralized. Those which strike north 20 to 30 degrees west are among the most prominent as to size and frequently contain some sulphide; at (18) fissuring in this direction tends to be mineralized, whereas fissuring in other directions is not.

All of the wide quartz veins or masses terminate abruptly, and many of those occurring within the softer rocks tend to be irregular pods about which the fissile rocks are warped and buckled. The quartz is white and crystalline, and in it the sulphides are erratically distributed as scattered grains, as veins, and as pockets or " nests " and " smears." In the softer rocks inclusions of schist in quartz are common.

Pyrite, when in solid or almost solid masses, seems to be intercrystallized with quartz and at the same time to be shattered and veined by quartz; pyrite occurs locally as a pyrite-quartz vein within a vein, and although there consequently appears to be a second generation of quartz it is indistinguishable as a rule from the main mass. Sphalerite, galena, and chalcopyrite with associated gold in some cases, notably the " Horne Tunnel " adit, are distinctly later than, and are found as veinlets in, the pyrite.

Siderite, which is light in colour when fresh and weathers to a deep brown to reddish colour, occurs in many veins as a common constituent, in small masses to pockets 2 feet or more in extent. Sericite is occasionally seen, but likely represents the digested remnant of a schist inclusion.

The principal showings will be enumerated in note form. Only passing mention will be made of the surface workings because they are relatively unimportant. The numbers refer to the numbered localities in Fig. 2.

(5) " Horne Tunnel " adit, elevation 5,425 feet, is driven northward into the base of a ridge 35 feet higher. On the top of this ridge is an exposure of quartz on or nearly on the crest of a complex drag-fold. The quartz appears to strike north-westward but is exposed for not more than 30 feet of length, and open-cuts have failed to pick up positive continuations, although apparently unrelated quartz is found to the south and north-west. The exposure is, on the top, practically barren of sulphides, but a shallow working 10 to 20 feet above the adit shows in the quartz a 5-foot cross-vein of almost solid pyrite, and it is on this cross-vein that the adit is driven.

The adit extends 36 feet at north 36 degrees east, and then 20 feet at north 35 degrees west. From 3 to 29 feet from the portal the adit is in quartz and some schist; massive pyrite is on the right wall for the first 9 feet, then for 5 feet on the left wall, and again on the right wall for the innermost 3 feet of this distance; through the remainder the quartz is lightly mineralized with pyrite and includes some schist. From 29 to 35 feet there is massive sulphide only on the right wall. It consists of a fine assemblage of pyrite, sphalerite, chalcopyrite, and galena. The same mineralization continues along the right wall of the north-westerly continuation of the adit, apparently as a vein 18 inches wide, with some additional quartz.

There appears to be, from all evidence, an irregular mass of quartz, some 10 by 30 feet on the surface, but highly irregular in downward continuation and in which there is an irregular north-easterly cross-vein of almost solid pyrite. A north-westerly vein, largely in rock, is composed of an assemblage of fine-grained sulphides. Three samples were taken: (*a.*) Eastern wall of adit, 7 to 12 feet from portal: Gold, 0.14 oz. per ton; silver, 0.3 oz. per ton. (*b.*) Wall, 36 feet from portal, representing a width of about 2 feet: Gold, 1.20 oz. per ton; silver, 1.6 oz. per ton. (*c.*) Across 52 inches on cross-vein on surface, 10 feet above portal: Gold, 0.30 oz. per ton; silver, 0.3 oz. per ton.

(6) At this point there is an open-cut on an irregular mass of quartz on the same fold as the " Horne Tunnel." The quartz is about 20 feet long by a maximum width of 8 feet; it lies east-west and contains considerable siderite, and locally a little pyrite. The quartz is not a continuous single mass but is irregular, and in the anticlinal crest it is clearly to be seen that in harder, quartzitic layers the quartz is stronger and in individual masses as large as 2½ by 4 feet, whereas in softer, phyllitic beds the quartz occurs only as stringers and small lumps.

Small showings of quartz are seen for 200 feet to the north-west along this structural axis and from 250 to 400 feet to the south-east, where stringers and veins up to maximum widths of 3 feet strike parallel to the structure, north, and north 75 degrees east. A forked vein 250 feet south-east of (6), with limbs up to 3 feet wide and 15 feet long, is mineralized with scattered pyrite, galena, and arsenopyrite; a sample of selected material assayed: Gold, 0.88 oz. per ton; silver, 0.5 oz. per ton.

(7) A mass of quartz, known as the " pinnacle," is in warped, schistose phyllites. It is an irregular, pear-shaped mass 25 feet long lying with the formation and with a north-easterly prolongation which gives a maximum width of 22 feet; the quartz appears to have no continuation except as a band 1 foot to 3 feet wide for an additional 25 feet to the south-east.

There is very little pyrite in this mass except at the " shank," where pyrite streaks occur over a width of 8 feet. The pyrite is coarse, up to half-inch cubes, and is shattered and seamed with quartz; a little sphalerite, galena, and chalcopyrite accompanies the pyrite. A selected sample of average solid sulphides assayed: Gold, 2.86 oz. per ton; silver, 0.1 oz. per ton.

A few small open-cuts up and down hill show a little irregular quartz in small widths. Between this locality and (8) there is a series of open-cuts partly exposing five quartz veins from 2 to 6 feet wide and with exposed lengths of from 10 to 30 feet. Of these one strikes north-westward and the others north-eastward; pyrite is present locally and tends to follow the walls.

(8) There are here two large masses of quartz, barren except for local pyrite. One forked vein is 120 feet long with a maximum width of 10 feet and a minimum of 2 feet of solid quartz; with a branch some 60 feet long and 2 to 4 feet wide. The quartz contains a few small pockets of pyrite and some inclusions of schist; it tends to follow directions of north 30 degrees east and north 80 degrees east.

The other large mass trends north 20 degrees east, has a total length of 70 feet and a maximum width of 19 feet of solid quartz at the centre. The walls are of schistose quartzite, some of which has been engulfed by quartz. Mineralization is confined to a single S-shaped veinlet of pyrite, 40 feet long, which crosses diagonally from wall to wall at the widest part. This veinlet is composed of much medium to fine-grained pyrite associated with quartz, and averages about 6 to 8 inches in width. A sample taken over 16 inches at the widest point assayed: Gold, 0.78 oz. per ton; silver, 0.6 oz. per ton.

(10) Is a prominent barren quartz vein several feet wide that strikes north and hooks round to the north-east at the north end.

(11) Is a quartz-body exposed for 57 feet, or nearly its total length, in a north 35 degrees west direction. It is 7 to 12 feet wide and is locally well-mineralized with pyrite, chalcopyrite, galena, and sphalerite, particularly for a length of 25 feet along the western wall. A selected sample, containing 50 per cent. sulphides in white quartz assayed: Gold, 0.32 oz. per ton; silver 0.9 oz. per ton.

(12) This is the "Stewart" vein, the largest body of quartz on the property. The vein is nearly 800 feet long and for the greater part of its length is 20 to 35 feet wide. The strike is approximately north for 400 feet from the southern end, where it splits into two members about 50 feet apart and with a strike of north 25 degrees west. Four isolated masses of quartz west of the western limb have not been traced.

The vein lies mostly in calcareous phyllites at a small angle with a prominent drag-fold along which there has been a slight dislocation. It is made up almost entirely of barren quartz with local, small patches of carbonate and local, small amounts of pyrite occurring in smears and stringers with associated rare chalcopyrite, arsenopyrite, and tetrahedrite. An adit, 54 feet long, is driven to crosscut the larger limb; from 38 feet from the portal to near the face it crosses a zone of quartz stringers and sericitic schist, and the innermost 4 feet is in almost barren quartz. Samples taken include: (*a.*) Chipped across the face of the adit: Gold, trace; silver, 0.2 oz. per ton. (*b.*) Selected from "powder tunnel" on west limb: Gold, 0.18 oz. per ton; silver, trace. (*c.*) Selected across sulphide veining at corner 100 feet south of fork: Gold, 0.12 oz. per ton; silver, 0.1 oz. per ton.

(13) Is a ribbing of quartz which attains a maximum width of 10 feet and is exposed over a distance of some 50 feet.

(14) Mineralization occurs near the crest of a drag-fold in a band of phyllite within the lower quartzites. Several open-cuts show irregular quartz in stringers and in widths to 4 feet locally. The mineralized quartz is apparently restricted to the phyllite, although small, barren and irregular stringers are abundant in the quartzites in this locality. The quartz contains well-mineralized pockets and stringers of galena and pyrite. A selected sample favouring galena assayed: Gold, 0.16 oz. per ton; silver, 20.2 oz. per ton; lead, 45.5 per cent.

(15) Is a north-south zone some 35 feet long (covered by snow at the south end). This is a stringer-zone a few feet wide, with one single band of quartz locally 3 feet in width. Sulphides, including galena, pyrite, and chalcopyrite, are scattered throughout and are abundant at the south end. A selected sample assayed: Gold, 0.26 oz. per ton; silver, 1.3 oz. per ton; lead, 3.3 per cent.

Some 100 feet to the south is a short 4- to 7-foot vein, strike north 15 degrees east, locally well-mineralized with coarse pyrite.

(16) There are here two large barren veins of white quartz locally containing small pockets of siderite. The larger vein, strike about north 20 degrees west, is about 400 feet long and up to 40 feet wide. The smaller mass is some 150 feet long and 15 feet wide, which is actually the main rib of a stockwork of quartz. Cross stringers and masses are irregular, and may be short gashes up to 6 feet wide; the common strike of these is between north 30 and 70 degrees east, with steep south-easterly dip.

(17) Here, in nearly flat quartzites, is a 10-foot zone of quartz stringers, trending northwestward. About 300 to 400 feet south-east of this point frequent stringers, striking northeastward, are mineralized with pyrite.

(18) Here are three veins which strike north 20 to 30 degrees west. The most westerly is about 6 feet wide at the northern end, is 12 to 20 feet wide for 30 feet, and then 1 foot to 7 feet wide to the southern end; a total length of 240 feet. This is part of a stockwork

with many offshoots trending north 30 to 70 degrees east as well as many at all angles. Pyrite is nowhere abundant and is found locally on the main vein, at intersections, and in some cross-veins.

A parallel vein 200 feet eastward is some 160 feet long, the northern end of which for 75 feet is 3 to 5 feet wide. South of a 30-foot extremely narrow section there is a widening to a maximum of 9 feet near the southern end. This vein is well mineralized with pyrite, particularly in the wider sections and at the northern end, where several open-cuts have been made. A selected sample of almost solid pyrite assayed: Gold, 0.34 oz. per ton; silver, 0.3 oz. per ton.

Midway between these two veins is a narrow, discontinuous vein-zone some 250 feet in length, along which there is scattered pyrite. It should be noted that there is definite evidence here of a pattern with wide quartz following a direction of north 20 to 30 degrees west, abundant veinlets and branches striking north 70 degrees east, and fewer striking north 30 degrees east. Pyrite is seen only in or close to the north-westerly set of fracturing, which is a direction of light shearing.

(19) Is a vein following the formation. It is 1,000 feet or more long, up to several feet in width, and contains locally very small amounts of pyrite.

(20) Is a 50-foot barren vein some 5 to 6 feet in width.

Conclusions.—There are on this property many quartz veins, of which some are very wide, none are very long, and many terminate abruptly. It is concluded that they are all fillings of fractures, along the walls of which there is no marked shearing. In the softer rocks, with the notable exception of the "Stewart" vein, the quartz-bodies are pod-like and with poor continuity. In quartzites there is a strong tendency, as at (16), (18), and at (21), south of the property, to form stockworks either at an angle to or parallel with the bedding. Mineralization within the quartzites consists almost entirely of pyrite, and in the softer rocks a complex mineralization is frequently seen.

Although sulphides leach out rapidly, their former presence can be detected readily from the pitted or cellular texture of the white quartz of an outcrop—this is not to be mistaken for the irregular, open pockets produced by the leaching of carbonate.

In many of the veins or masses sulphide occurs only locally, in pockets, veins, or "smears." Some of this pyrite seems to have come in with a later generation of quartz, but one that is hard to detect. It seems to be an important point that in the "Horne Tunnel" the best values are related to copper-lead-zinc minerals that are definitely later than the pyrite.

The different behaviour of the fracturing and, consequently, the difference in form and mineralization in passing through different sorts of rocks should be borne in mind. In a folded region of a heterogeneous assemblage of hard and soft rocks development should proceed with caution.

Azure River Valley.

A few claims were once held under the name of the *War Colt* group near the mouth of Warcolt Creek. The original holdings expanded and in 1933, when owned by Albreda Holding Company, Limited, the number of claims was increased to thirty-six. All of these claims had lapsed by 1938 and the boundaries of the former group are not known, but it is evident that a few years ago all of the upper Azure River Valley was staked, from below Warcolt Creek to the headwaters.

The various showings and workings found by the writer in this general section are no different in general character from those already described. At (1), in schistose phyllites, is a large exposure of quartz on which a little work has been done. This mass has one well-defined boundary trending north 55 degrees east, 45 feet in length; the quartz is about 10 feet wide at each end and a swelling to the south-east reaches a maximum distance of 30 feet from the boundary-line. No serious attempt has been made to trace this mass farther, although these are the apparent limits. The quartz is barren except for a 30-foot band of sulphides up to 30 inches wide along the north-west boundary and a shorter, parallel band 3 feet wide extending from the centre of the mass north-east. Mineralization is not abundant and includes chalcopyrite, tetrahedrite, galena, sphalerite, and pyrite. A selected sample of the heaviest mineral assayed: Gold, 0.84 oz. per ton; silver, 8.8 oz. per ton; copper, 2.9 per cent.; lead, 3.1 per cent.

(2) This is the *War Colt* tunnel, the first discovery in the district. It is a short adit at river-level, driven 16 feet in a north-easterly direction in schistose, quartzitic, and softer beds; at the portal an open-cut extends north-westward for 45 feet, and three small open-cuts lie to the south and south-east. The structure is not clear, and there is more than one body of quartz.

In the adit the innermost 5 feet is in smoky quartz and siderite with one north-south boundary. The north-westerly-trending vein at the portal contains much siderite and is 3 to 6 feet or more wide, pinching out at both ends. Pyrite is locally abundant at the portal and chalcopyrite is abundant to the north-west, which latter mineral is frequently seen to occur in veinlets traversing carbonate, accompanied by films of quartz; there is also some galena and a very little sphalerite. Three selected samples were taken from the dump: (*a.*) Favouring pyrite in quartz: Gold, 0.10 oz. per ton; silver, 2.5 oz. per ton. (*b.*) Favouring chalcopyrite in carbonate and quartz: Gold, 0.12 oz. per ton; silver, 4.1 oz. per ton; copper, 7.3 per cent; lead, 2.5 per cent. (*c.*) Favouring galena in quartz: Gold, 0.06 oz. per ton; silver, 27.5 oz. per ton; copper, 2.5 per cent.; lead, 18.9 per cent.

Quartz shows in two open-cuts near the adit, but there is no obvious connection with the above-mentioned veins and the cuts are in a bad state of repair.

(3) At the junction of Canyon Creek and Azure River there is a showing of quartz and siderite about 10 feet square in plan. A band of pyrite 6 inches wide follows one east-west wall and a parallel zone of pyrite mineralization 1 foot to 2 feet wide traverses the mass. A selected sample of fairly solid pyrite assayed: Gold, 0.08 oz. per ton; silver, 0.3 oz. per ton.

There are other indications of quartz in this locality, but no continuity is proved and some exposures are only doubtfully in place.

(4) Is a barren quartz mass some 6 by 25 feet as exposed, on which a little work has been done. The strike is north-westward.

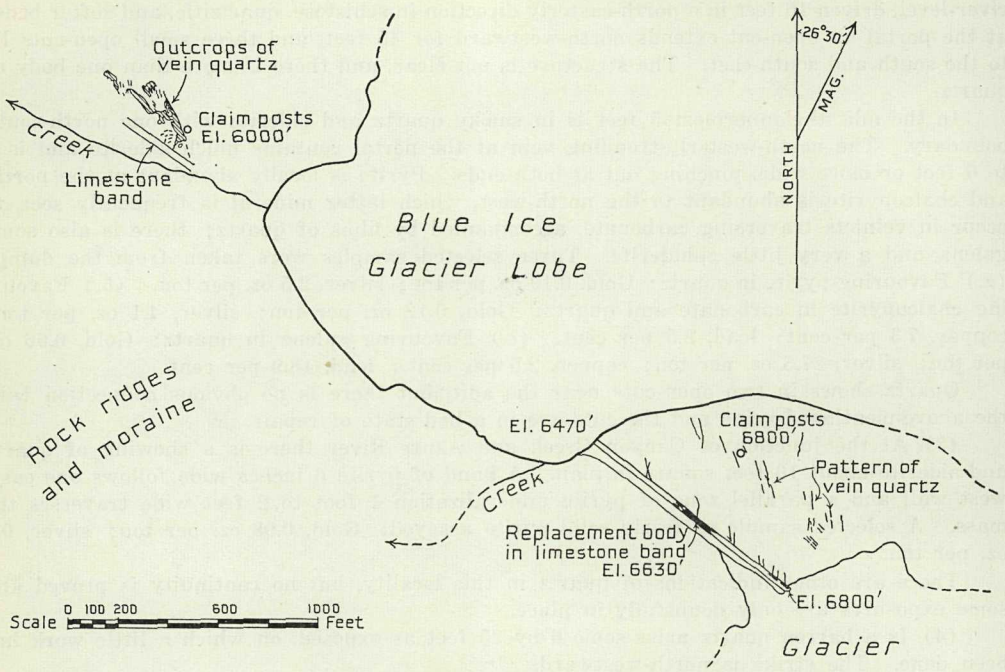
Other, natural, showings in upper Azure River Valley include the already-mentioned broad belt or zone of quartz veins, in the upper quartzites, which passes through the high peaks and crosses the southern end of the meadows. These veins were not closely studied but those seen were largely barren. Many can be seen from a distance on the eastern summits and slopes of the high peaks, down and over the "ridge face," elevation 7,310 feet, and in the glacier basin at the head of the river.

A large vein is seen at an elevation of 6,200 feet in the first big creek north of Summit Creek on the east side of the valley. This point is about 200 feet below the contact of the lower quartzites with overlying phyllites, which contact would seem to be remarkably straight from here to the Hobson Creek pass. The vein is 75 feet long by 15 to 30 feet wide as exposed, and consists of bluish, vitreous quartz cut by stringers of white quartz. Local carbonate and small amounts of pyrite are not related to these stringers, which are barren.

Blue Ice. This group of twenty-two claims is at the head of a branch of Hobson Creek known by some as Fredwells Creek. It was optioned in 1938 by W. R. Johnson and associates, of Blue River, to Anglo-Huronian, Limited. A trail was constructed from Hobson Lake almost to the property, where a cabin was built, and a diamond-drill and supplies were stored at Hobson Lake ready for a programme of development early in the coming season.

The north-eastern corner of the group is on a prominent ridge, surrounded by ice, which leads north-westward from the 8,605-foot peak, and the northern margin crosses a prominent glacier lobe (*see* Figs. 1 and 3). Below the ice-sheets the ground is largely covered by moraine, through which project rock ridges. The southern and western part of the group is one of scantily-timbered hillside. North of the main creek is a prominent steep-sided ridge, and the main creek follows westward then north-westward at the base of this, after falling several hundreds of feet below a rocky platform a quarter of a mile or so below the glacier.

The rocks are all members of the upper quartzites. They are quartz-grain rocks of many types, many have a silty, now sericitic base, and most are thick-bedded. Thin bands of phyllite or quartz-sericite schist are to be seen; these represent more silty phases of the metamorphosed sandstone series. There is one band of dark-grey limestone, about 20 feet wide, which is only locally exposed between stretches of ice and moraine; it is reported to



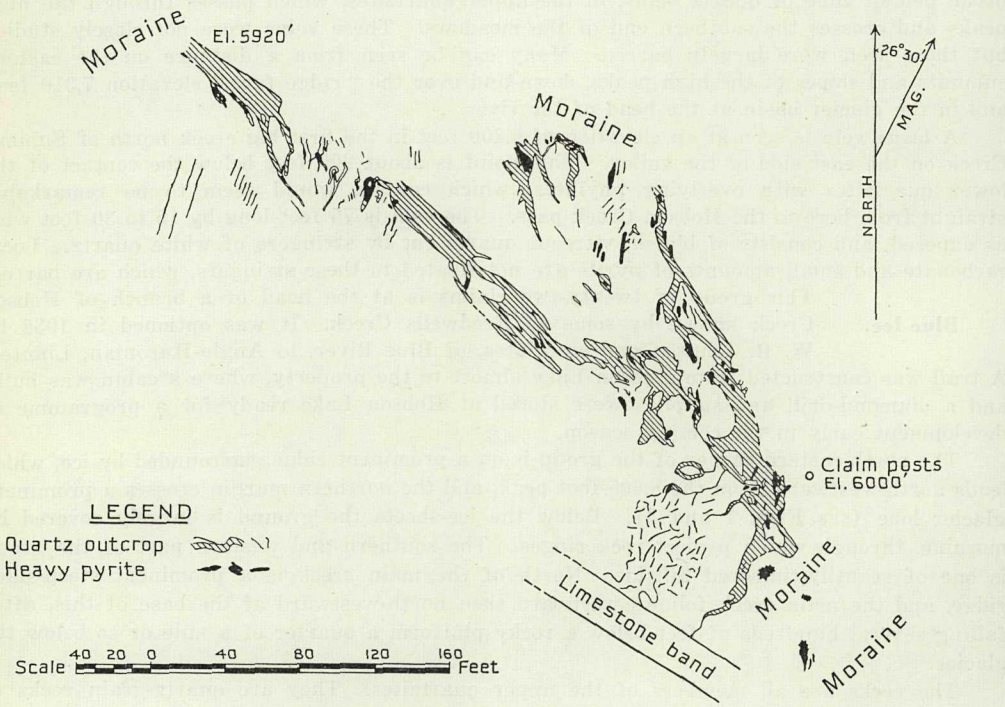


Fig. 3. Blue Ice group at head of Hobson Creek.

Top figure: Distribution of principal showings. Bottom figure: Detail of outcropping of vein quartz in quartzite, as exposed on rock ridge, surrounded by moraine, north-west of glacier.

continue some considerable distance to the north-west, but was not found by the writer to extend as far as Azure River on the south-east. The strike of the formation is about north 55 degrees west and the dip is 80 degrees or more to the north-east. Farther to the north-east the quartzites are vertical or with steep dip either way, and in the high peak north of the glacier are seen to be folded over flatly, about half a mile from the Blue Ice Glacier lobe.

The quartzites, over a belt a mile in width, are traversed by many quartz veins and stringers. Few of these are either large or long, and many are actually narrow, irregular stockworks or more commonly sets of short quartz-filled cracks and gashes crossing the beds nearly at right angles. Carbonate is a common accessory of the quartz veins. Sulphides occurring locally include pyrite and small amounts of chalcopyrite, galena, sphalerite, and arsenopyrite. Mineralization has extended into the limestone-band locally to form an almost solid pyrite replacement.

There are three areas to be described in detail (*see* Figs. 1 and 3). That indicated in the south-west corner of the group is a quartz vein, locally of considerable size, the upper end of which is at an elevation of 6,600 feet, south-east of which there is, probably, a smaller continuation as a vein or stringer-zone for several hundreds of feet.

The vein is well exposed from this upper point for over 600 feet to an elevation of 6,400 feet, along a line trending a little west of north. The upper 200 feet of length ranges in strike from north to nearly east, north of which point there is a split for 150 feet, beyond which the vein continues northward for 250 feet as a single crooked strand 3 to 8 feet wide. At the upper end the vein is 6 to 8 feet wide, and for the remainder of its length it is 4 or 5 feet wide with local enlargements to 15 feet. A dark-weathering siderite, occurring in nests to several feet across, is common.

Mineralization consists of pyrite with, chiefly at the upper end, chalcopyrite and small amounts of galena and sphalerite. Mineralization is restricted chiefly to the uppermost 200 feet as exposed and to the lowermost end. The greater part of the vein by far is barren. Three selected samples were taken at the upper end:—

(1.) From upper open-cut: Gold, 0.62 oz. per ton; silver, 2.4 oz. per ton.

(2.) From second open-cut, fine pyrite: Gold, 2.90 oz. per ton; silver, 0.3 oz. per ton.

(3.) Almost solid sulphide, including a little chalcopyrite and galena: Gold, 0.60 oz. per ton; silver, 7.0 oz. per ton; copper, 2.1 per cent.

A sample chipped across 20 inches of pyrite showing in the lowermost open-cut assayed: Gold, 0.02 oz. per ton; silver, 0.2 oz. per ton.

At the most northerly exposure, at the claim posts, 6,000 feet elevation, is a knoll of quartzite surrounded by moraine (*see* Fig. 3). The mineralization was mapped, as exposed, in considerable detail, although the full complexity is not here reproduced. On the plan the chief concentrations of pyrite in quartz are indicated. The full extent of this complex of quartz-veining is not known.

As shown in the plan, the total exposed length is 460 feet and the greatest width 120 feet; individual widths of quartz are as great as 20 feet. One prominent direction of fissuring is north 55 degrees west, parallel to the formation, another trends about north 30 degrees west, and a third north 15 degrees east; the dip in all is very steep. Quartz parallel to the bedding is mostly barren; that diverging 25 degrees from it is poorly mineralized. Pyrite is found to occur commonly in short quartz veins and lenses, and within the larger quartz-bodies as lenses or veins, which for the most part strike with the third set of fracturing, north 15 degrees east. Short gashes of this set are not infrequently seen aligned as a belt trending north 30 degrees west, and it is judged that they are tension-gashes and that pyrite has largely entered the rocks along fissures produced by tensional stresses, whereas the greatest amount of quartz followed avenues of very light shearing.

There is a sericitic alteration of the rocks in this general zone that is more prominently developed here than elsewhere on the property. Pyrite is locally found in small masses within the sericitized quartzite at or close to bodies of quartz and also, rarely, several feet distant.

Sampling of such a deposit is, of course, difficult, and a few samples only were taken, of selected material in each case:—

(1.) Coarse, cubical pyrite (20 per cent.) in quartz: Gold, 0.06 oz. per ton; silver, 0.1 oz. per ton.

(2.) Almost solid pyrite: Gold, 2.82 oz. per ton; silver, 1.8 oz. per ton.
(3.) Quartz with 3 to 5 per cent. pyrite: Gold, 0.02 oz. per ton; silver, 0.2 oz. per ton.
(4.) Quartz with 75 per cent. pyrite: Gold, 0.18 oz. per ton; silver, 0.2 oz. per ton.
(5.) Pyrite stringer in schist: Gold, 1.44 oz. per ton; silver, 1.6 oz. per ton.
(6.) Pyrite mass in schist: Gold, 0.68 oz. per ton; silver, 0.5 oz. per ton.
(7.) Siderite with trace of pyrite, from quartz stringer: Gold, *nil*; silver, *nil*.

A great number of samples would, of course, have to be taken before generalities could be made regarding the localization of values.

The limestone-band is not here mineralized, and quartz is seen to reach the margins of that body without penetrating it. The intersection of the main mass of quartz with limestone is covered by moraine.

Another area of quartz-veining with local pyrite lies some 2,000 feet to the south-east, at elevations between 6,600 and 7,000 feet. The veining there is much more widely spaced, the generalized pattern of which is shown in the upper part of Fig. 3. The same three sets of fissuring are developed, but that set parallel to the formation is very weak. Pyrite occurs in both of the other sets, but perhaps favours that which strikes north 10 to 20 degrees east. Widths of quartz are extremely variable over lengths up to 200 to 300 feet. Pyrite mineralization is locally almost solid in some veins, over widths from a few inches to several feet and for lengths of a few tens of feet at the most. Samples of well-mineralized quartz include:—

(1.) Almost solid pyrite near claim posts: Gold, 0.16 oz. per ton; silver, 1.4 oz. per ton.
(2.) Across 10 inches of a well-mineralized vein: Gold, 0.80 oz. per ton; silver, 0.4 oz. per ton.
(3.) Across 13 inches of a strongly-mineralized vein: Gold, 0.34 oz. per ton; silver, 0.5 oz. per ton.
(4.) Quartz containing 60 per cent. pyrite, 200 feet north-west of posts: Gold, 0.32 oz. per ton; silver, 2.1 oz. per ton.
(5.) Across 24-inch vein, 80 per cent. pyrite, 200 feet east of posts: Gold, 0.52 oz. per ton; silver, 0.3 oz. per ton.
(6.) Quartz with 60 per cent. pyrite, from north 60 degrees east vein, east of posts: Gold, 0.66 oz. per ton; silver, 4.5 oz. per ton.

This general belt or zone of veining continues in part up the ridge southward along the formation, but mineralization is more scanty; part of the zone is undoubtedly covered by ice.

A section of the limestone-band some 875 feet long is continuously exposed and passes beneath ice at each end. A section of the band is heavily mineralized with pyrite, forming a replacement-body of considerable size near the centre of the exposed band.

The limestone is replaced over the full width of 18 or 19 feet for a length of 110 feet, in addition to which replacement averages 10 feet wide for 40 feet, counting both ends of the main, solid mass. In addition, there are stringer-like prolongations 1 foot to 5 feet in width for 60 feet north-west and 30 feet south-east. Near the south-east end of the limestone a little replacement is seen on the north-east wall and a very short similar section is found near the lower end of the band. The replacement mineralization seems definitely related to small pyrite- and carbonate-bearing cross-fissures in the quartzites.

In the main replacement-body abundant to almost solid pyrite occurs in a carbonate gangue which seems in part at least to be composed of siderite. The margins of the body are definite, and it is only on the extreme south-eastern ragged end that the body consists largely of carbonate with a small amount of pyrite. Pyrite comprises 50 to 90 per cent. of the mass, varying in coarseness from a fine, sugary texture to cubes an inch and more on the edge. A little arsenopyrite is seen locally. Owing to the heavily-oxidized surface and the massive nature of the deposit it is difficult to obtain fresh specimens and, consequently, two specimens were obtained northwest of the glacier from boulders in no apparent respect different from this body. Microscopic examination showed the pyrite to occur in limestone with a carbonate (siderite and possibly including some ankerite) gangue; the pyrite ranged in size down to 5 microns, but in the two specimens examined the size was largely above 315 mesh in one and above 200 mesh in the other.

A sampled was channelled in sections across a width of 18 feet near the centre of the body from the hanging-wall.

(1.) Five feet from north-east wall, nearly solid pyrite: Gold, 0.74 oz. per ton; silver, 0.3 oz. per ton.

(2.) Next 5 feet, 75 per cent. pyrite: Gold, 0.16 oz. per ton; silver, trace.

(3.) Next five feet, 75 per cent. pyrite: Gold, 0.24 oz. per ton; silver, 0.6 oz. per ton.

(4.) Next 3 feet to within 8 inches of foot-wall, 25 per cent. pyrite: Gold, trace; silver, 0.2 oz. per ton. The weighted average of this section gives: Gold, 0.32 oz. per ton; silver, 0.2 oz. per ton. Other samples were taken south-east of this line:—

(1.) Ten feet south-east, almost solid fine pyrite near foot-wall, 2 feet wide: Gold, 1.96 oz. per ton; silver, trace.

(2.) Thirty feet south-east, almost solid coarse pyrite near centre, selected: Gold, 0.62 oz. per ton; silver, 0.4 oz. per ton.

(3.) Forty feet south-east, 5-foot channel to 1 foot from foot-wall, average section: Gold, 0.28 oz. per ton; silver, 0.3 oz. per ton.

(4.) Eighty feet south-east, channel across zone where 5 feet wide and composed almost entirely of carbonate: Gold, *nil;* silver, *nil.*

All samples were taken of fresh material, and a sample of accumulated oxides in a crevice returned low values, so it is not thought that these samples were affected by secondary enrichment. It is reported that later in the season the capping was blown off parts of the body.

It is reported that beneath the present glacier front there were workings in past years, but that a recent advance of the ice has covered these. The work was done, it is said, on "cross-leads." There is evidence of this being so, but there was in 1938 no possibility of climbing beneath the ice. In addition to quartz veins there exists strong evidence of there being a replacement-body beneath the ice in the presence of considerable float in the moraine north-west of the glacier-stream discharge. Small blocks and boulders to half a ton in weight are to be seen, and it is not at all likely that this float came from the body described above.

Development of the *Blue Ice* showings offers considerable difficulty owing to the location. Being in a heavy snow-belt adjacent to an active glacier none but temporary workings on or near the showings are feasible, and the closest possible adit site involves driving about 1,000 feet to reach the upper replacement-body. A protected site for an adit that would reach and ultimately explore all worth-while sections about the glacier can be found, but a considerably longer crosscut would be necessary to reach the north-western edge of the glacier front.

Kettle River Area.

Horseshoe Mountain.

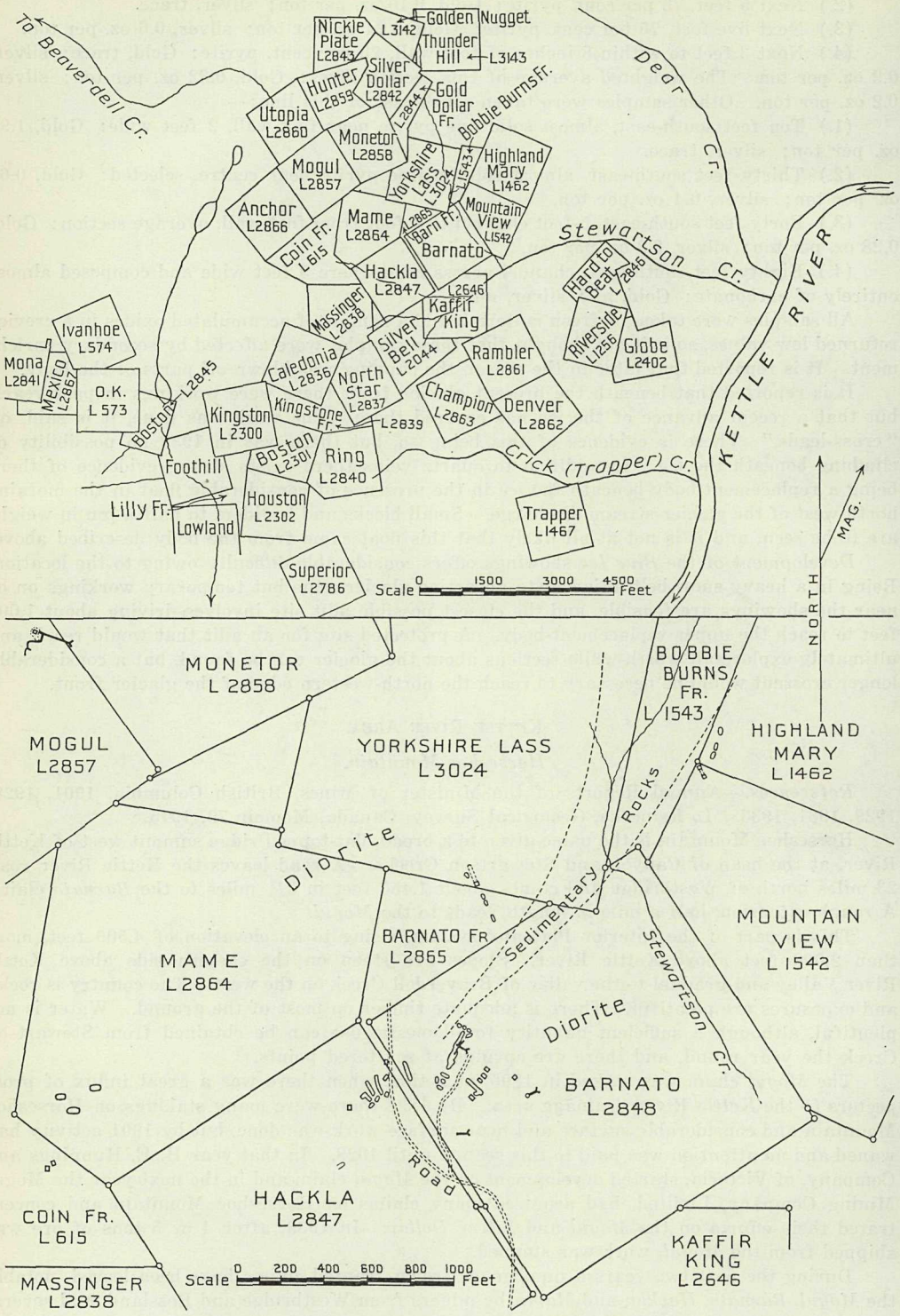
References.—Annual Reports of the Minister of Mines, British Columbia, 1901, 1928, 1929, 1931, 1933. L. Reinecke, Geological Survey, Canada, Memoir 79, 1915.

Horseshoe Mountain is the name given to a broad, flat-topped ridge summit west of Kettle River, at the head of Canyon and Stewartson Creeks. A road leaves the Kettle River road 23 miles north of Westbridge and climbs about 1,450 feet in 3¼ miles to the *Barnato* claim. A rough extension, half a mile in length, leads to the *Mogul.*

This is part of the Interior Plateaux system, rising to an elevation of 4,500 feet, more than 2,000 feet above Kettle River. Slopes are steep on the eastern side above Kettle River Valley and gradual to the valley of Beaverdell Creek on the west. The country is rocky and exposures are plentiful. There is adequate timber on most of the ground. Water is not plentiful, although a sufficient quantity for domestic use can be obtained from Stewartson Creek the year round, and there are springs at scattered points.

The *Mogul* claim was staked in 1896, at a time when there was a great influx of prospectors to the Kettle River drainage area. By 1898 there were many stakings on Horseshoe Mountain and considerable surface and near-surface work was done, but by 1901 activity had waned and no attention was paid to this section until 1928. In that year H. E. Hunnings and Company, of Victoria, started development on the *Mogul* claim and in the next year the Mogul Mining Company, Limited, had acquired many claims on Horseshoe Mountain and concentrated their efforts on the *Mogul* and *Silver Dollar.* In 1933, after 4 or 5 tons of ore was shipped from the *Mogul,* work was stopped.

During the past two years a number of Crown-granted claims have been leased, notably the *Mogul, Barnato, Hackla,* and *Mame,* by miners from Westbridge and Rossland, and several cars of sorted ore have been shipped. Much lapsed ground has been restaked and new discoveries have been made, extending down to the Kettle River. In the fall of 1938 Consolidated Mining and Smelting Company of Canada, Limited, diamond-drilled and test-pitted the



Map of Claims on Horseshoe Mountain, Kettle River.

Top figure: Copy of part of Mineral Reference Map No. 4T300. Bottom figure: Enlarged section showing approximate position of principal workings.

Barnato, but found the results of the work not sufficiently encouraging to exercise options on this and adjoining claims.

General Geology.—The geology of the summit and western part of Horseshoe Mountain was mapped by Reinecke, and is illustrated in his Memoir on the Beaverdell Map Area. The writer found more quartz diorite than is indicated on Reinecke's map, but did not trace any boundaries.

In the area under discussion, a body of Westkettle quartz diorite intrudes lavas and tuffs of the Wallace formation, and both rocks are cut by porphyry dykes. Stratified rocks, including tuffs and some normal sediments, are found principally on the upper and northern slopes, and andesitic rocks and some tuffs predominate on the lower Kettle River slopes. Some phases of the Wallace volcanics are coarse enough to resemble finer and darker-coloured phases of the quartz diorite, but careful scrutiny is sufficient to prove that the former belong to the older series. There are many porphyritic, andesitic to syenitic dykes of which most are post-mineral.

The mineral-deposits have been classed by Reinecke as "stocks" because they are commonly irregular in shape and occur in rock with or without quartz. The term is not in common use to-day, and they are perhaps best considered as mineralized zones of irregular fracturing, in which mineralization is in the form of vein-like bodies and impregnations. Mineralization includes pyrite, pyrrhotite, arsenopyrite, sphalerite, and chalcopyrite, in which the valuable constituent is gold.

There has been little or no shearing, but rather light and irregular fracturing which has produced single or complex fissures or breccia-zones. There is commonly a rock alteration that is marked by sericitization in its weaker phases and by the production of kaolin (dickite), chlorite, actinolite, epidote, and locally diopside in stronger phases. There is in stronger phases secondary quartz and in the *Barnato* veinlets of quartz and secondary microcline. These products of hydrothermal alteration grade into silica and in turn into white vein-quartz, which latter is not abundant. A full study of this alteration would require far more microscopic study than has been attempted.

There are zones of brecciation, chiefly on the lower eastern slopes, which have to date received little attention. The rock is a mottled green and whitish product in which green fragments are rich in actinolite and the light fragments are largely chert, including some chlorite. Mineralization is weak, as a rule, and consists of pyrite and locally pyrrhotite and chalcopyrite.

There is no free gold discernible in hand specimens, but gold may be panned from many of the oxidized outcrops of mineral matter. Arsenopyrite and pyrrhotite were the earliest sulphides formed, and gold has, in some cases, proved to have been introduced at a later date in company with pyrite (and sphalerite). This may well account for the erratic values obtainable in sampling.

Barnato. This Crown-granted claim has been leased by F. O. Peterson, of Westbridge, for three years, and for a short time in 1938 was optioned to Consolidated Mining and Smelting Company of Canada, Limited. It is immediately south of Stewartson Creek and just below the road.

The upper section of the claim, where the workings are situated, is underlain by quartz diorite, and a narrow band of fine-grained sediments extends through this part from the north-east. There are a number of light-coloured porphyry dykes, andesitic in character. Development-work consists of a number of open-cuts and one adit, including 25 feet of a crosscut and 50 feet of drifting. The Consolidated put down four or five diamond-drill holes to explore the principal mineral-zone at depth.

The principal zone is associated with an irregular narrow fissure which strikes north 35 degrees east and dips 70 degrees south-eastward. The fissure is drifted on for 50 feet, elevation 3,800 feet, and is seen to be only locally mineralized; 60 feet south of the adit it is faulted 15 feet to the east, and in the continuation contains patches of heavy arsenopyrite up to 8 inches wide. Open-cuts show what is apparently the same fissure, extending 80 feet northward from the adit and 200 feet southward, as a mineralized zone a few inches in width.

The drift at the southern end is holed through into a large open-cut. There the full width of mineralization is not seen, but it appears to be some 12 feet wide. It consists of bands, stringers, irregular masses, and impregnations of sulphides; this is the strongest

mineralization noted on the property. Two or three bands of sulphide are seen in the drift and in the crosscut. The mineralization is not everywhere directly related to the fissure, but is localized close to it and there is no apparent structural reason for the wide section noted.

The quartz diorite has been strongly altered, first to a bleached, sericitized rock and more intensely to a soft whitish mass consisting almost entirely of kaolin. In the more advanced phases of alteration there is some secondary quartz and microcline and locally a little epidote; the dioritic texture is almost or completely destroyed. Sulphides include pyrite, arsenopyrite, sphalerite, pyrrhotite, chalcopyrite, and galena. Microscopic examination by the Mines Branch, Ottawa, shows the paragenesis to be arsenopyrite, pyrite, sphalerite, chalcopyrite; and by the Mines Department, Victoria, to be arsenopyrite, pyrrhotite, pyrite, sphalerite, chalcopyrite, and galena. The gold is definitely later than the arsenopyrite and is related to pyrite and sphalerite; some of the gold is post-pyrite. There is locally some vein-quartz, but commonly the sulphides occur in rock that is more or less silicified and which grades into dense, watery-looking quartz.

Considerable of the pyrite presents a peculiar feathery to botryoidal appearance and weathers to a cellular "lacy" texture. It strongly resembles marcasite but is definitely pyrite. It is unique, and is fairly characteristic of Horseshoe Mountain.

Other open-cuts to the south-east, and an old adit and shallow shaft, show small widths of chiefly pyritic mineralization. The strike is apparently north-eastward in each, although some of the mineralization is extremely irregular. Open-cuts were being made by Consolidated in September, not all of which are shown on the accompanying sketch-map. These were designed to explore continuations of the principal zone and the possibility of parallel or branch zones.

Several cars of ore that have been shipped by F. O. Peterson gave variable returns in gold, the better assaying more than 1 oz. gold per ton. The better cars however contained considerable oxide and also solid arsenopyrite (with some pyrite) from a narrow, high-grade stringer 60 feet southward of the adit.

Several samples were taken, to illustrate the variation in gold content, as follows:—

(1.) Across 20 inches strong sulphide in drift, 25 feet south of crosscut: Gold, 0.50 oz. per ton; silver, 0.3 oz. per ton.

(2.) In large open-cut at south end of drift, selected "lacy" pyrite: Gold, 1.44 oz. per ton; silver, trace.

(3.) The same, selected solid arsenopyrite, pyrite and sphalerite: Gold, 0.56 oz. per ton; silver, trace.

(4.) From 60 feet south of crosscut, narrow zone of arsenopyrite and trace of pyrite: Gold, 16.48 oz. per ton; silver, 0.1 oz. per ton.

(5.) Open-cut 75 feet north of adit, selected from dump: Gold, *nil*, silver, *nil*.

(6.) Northern face of drift, across 56 inches, small amount of pyrite: Gold, *nil;* silver, *nil*.

(7.) Dump of old shaft: Gold, 0.44 oz. per ton; silver, trace.

(8.) Open-cut, 200 feet southward from adit, small pyritic zone: Gold, trace; silver, trace.

On the *Barnato Fraction* and extending over the boundary of the *Yorkshire Lass* is a line of old workings 240 feet long in a north 25 degrees west direction. A small shaft is on the *Yorkshire Lass*, and there are several old open-cuts. A narrow zone of mineralization is poorly exposed along this line.

Hackla. This claim, at least in its northern part, is underlain by quartz diorite. About 650 feet south of the northernmost corner is an open-cut 7 by 20 feet in a north-easterly direction. A mineral-zone 3 to 4 feet wide in the open-cut is cut off by a porphyry dyke and no extension is proved. Mineralization, within altered quartz diorite, is locally massive and grades into silicified rock. Sulphides include pyrrhotite, pyrite, arsenopyrite, and a little chalcopyrite; pyrite is younger than pyrrhotite and arsenopyrite and is seen locally to contain small cavities surrounded by a rim of pyrite with colloform texture. There is a pile of about 25 tons on the dump and 12 sacks of fine oxide. Samples assayed:—

(1.) Chipped from pile on dump: Gold, 0.38 oz. per ton; silver, trace.

(2.) Grab of fine oxides in sacks: Gold, 0.24 oz. per ton; silver, trace.

A shaft 270 feet northward from this open-cut is perhaps 40 feet deep, now inaccessible. It is sunk on a vein-zone with a strike of north 80 degrees east and a dip of 65 degrees south, 1 foot to 2 feet wide. Mineralization consists of pyrrhotite, pyrite, and arsenopyrite, in silicified quartz diorite, and of pyrite and arsenopyrite in vein-quartz of erratic distribution within the zone. Selected samples from the dump assayed:—

(1.) "Lacy" pyrite in quartz: Gold, 0.10 oz. per ton; silver, 0.1 oz. per ton.

(2.) Favouring pyrrhotite: Gold, 0.34 oz. per ton; silver, trace.

(3.) Favouring arsenopyrite: Gold, 0.26 oz. per ton; silver, trace.

From this shaft in the direction of the upper *Barnato* workings are a number of open-cuts and strippings, some of which are old and some recent. A small old open-cut on the road shows two narrow zones 5½ feet apart, striking north 60 degrees east and with steep dips; these contain a little pyrite and a little quartz to a maximum local width of 10 inches. A second old open-cut and small stripping on the road is probably on the *Barnato Fraction.* Erratic mineralization includes pyrrhotite, arsenopyrite, and pyrite. A selected sample heavy in pyrrhotite assayed: Gold, *nil;* silver, *nil.* A similar sample favouring arsenopyrite assayed: Gold, trace, silver, trace. Other open-cuts and strippings show indications of mineralization.

Mame. On this Crown-granted claim there are three shallow workings in quartz diorite near the south-west corner. The most easterly of these, elevation 4,250 feet, is an open-cut deepened to 14 feet; it is on a zone which strikes north 85 degrees east and dips 65 to 70 degrees south. The zone is a few inches to several feet wide and contains erratic, patchy pyrrhotite and pyrite in silicified rock or in quartz. There is said to be here a distinct pyritic band of high grade, but this was not distinguished. There is an ore-pile of about 25 tons on the dump, and from it samples assayed:—

(1.) Chipped from all over dump: Gold, 1.68 oz. per ton; silver, trace.

(2.) Selected "lacy" pyrite: Gold, 0.52 oz. per ton; silver, trace.

The most southerly of the three open-cuts is 5 by 44 feet in a direction of north 60 degrees east. In it a zone, dipping 75 to 80 degrees south-east, is 1 foot to 2 feet wide and contains pyrite and pyrrhotite in silicified rock, together with a little quartz. Below a fault in the bottom of the open-cut there shows an east-west band, 4 to 5 feet wide, of similar mineralization in stringers.

The north-westerly open-cut is 6 by 22 feet long in a direction of north 82 degrees east. A vague, steeply-dipping zone is up to 4 feet wide and the limit of scattered mineralization is as much as 8 feet in width. A sample across 4 feet, including pyrite and pyrrhotite and a little quartz in silicified rock, assayed: Gold, 0.22 oz. per ton; silver, trace.

Highland Mary and Mountain View. These claims, of which the former is Crown-granted, lie north-east of Stewartson Creek on a tongue of quartz diorite with sediments to east and west. There are many porphyritic dykes, andesitic to syenitic in composition, some at least of which are younger than the mineralization. Showings are just within adjacent corners of the two claims at an elevation of about 4,050 feet; there are three open-cuts in line up the hillside and below are two pits at the ends of a 30-foot open-cut.

The uppermost open-cut shows on the south side a 20-inch zone, strike north 25 degrees east and dip 65 degrees eastward, composed of almost solid arsenopyrite; on the north side of the open-cut there is merely a stringer-zone containing narrow bands of arsenopyrite. In the second highest cut is a rusty band 2 inches wide with strike as above and dip 60 degrees westward. In the third open-cut is an arsenopyrite-quartz vein up to 26 inches wide, strike north-east, which is traceable for 30 feet and is cut off by dykes. A sample across 26 inches of this vein assayed: Gold, trace; silver, trace.

In the lowest open-cut, in the pit in the west end, is a zone bearing arsenopyrite, pyrrhotite, and pyrite in quartz; the zone is 2 feet wide, striking north 40 degrees east with vertical dip. In the eastern pit in the same cut, 30 feet distant, is a vein-zone about 9 inches wide, strike north 30 degrees east and dip 75 degrees south-eastward. A sample across 8 inches, containing much arsenopyrite and some pyrrhotite and pyrite, assayed: Gold, 0.50 oz. per ton; silver, 0.3 oz. per ton.

Mogul. This Crown-granted claim is the oldest on the hill and on it most work has been done. It is at an elevation of 4,500 feet on the summit of the ridge. The claim has been leased by Clyde Sherdahl, of Rossland and Westbridge, for three years, and from it he has shipped several car-loads of sorted ore.

A vertical shaft was sunk in early days and later deepened to 50 feet. An adit, collared on *Monetor* ground, is driven north 70 degrees west for 140 feet, where a raise a few feet long breaks into the bottom of the shaft. Fifteen feet short of the shaft a branch leads southward 20 feet, then westward 45 feet, then southward 45 feet. A dyke some 30 feet wide crosses the adit, the western wall of which is followed 15 feet southward to pick up the shaft-vein, 10 to 12 inches wide, strike east and dip vertical. This is followed 16 feet when it is faulted a few inches and the strike changes to north 65 degrees east for 16 feet; past a second fault of small displacement the east-west vein is followed for 20 feet, and the crosscut to the south crosses a quartz vein 24 to 30 inches wide and 10 feet distant. About 50 feet from the portal of the adit on the northern wall is a short section of vein 6 inches wide, strike north 65 degrees east, dip 70 degrees south-eastward.

Mineralization consists of pyrite, pyrrhotite, and a little arsenopyrite in silicified quartz diorite, with little true vein-quartz. The vein-zone is from a few inches to 2 feet wide and is most irregular; it is seen in the shaft to be offset by and perhaps associated with flat faults, and the shaft has been glory-holed in order to follow the short sections. A sample across 28 inches, 10 feet below the collar of the shaft, assayed: Gold, 1.68 oz. per ton; silver, trace. A sample across 13 inches, 50 feet from the portal of the adit, on mineralization not apparently related to that in the shaft, assayed: Gold, 1.50 oz. per ton; silver, trace.

The same vein-zone is traced positively on the surface for some 200 feet at south 60 degrees west, where it is offset by a large dyke. It ranges from a stringer to a local maximum of 3 feet.

Ivanhoe. This Crown-granted claim near the Triple Lakes is leased by Stan Peterson and associates, of Westbridge. It is reached by a narrow-gauge road about 2 miles in length from the main Horseshoe Mountain Road. The claim is in an area of Wallace formation, but quartz diorite outcrops locally.

Old workings, at an elevation of 4,350 feet, were seen before much new work had been done on them and it was difficult to size up the deposit. There is, in quartz diorite, an irregular narrow vein-zone, vertical and with variable northerly strike. It is a few inches wide to locally a foot or so, and consists of glassy quartz containing pyrite, arsenopyrite, and a trace of chalcopyrite, as well as stringers of pyrite in rock. There may be two zones, which show in two 15-foot pits, or a single zone which has been faulted. There are a few very old and now obscure open-cuts near-by.

Several tons were on the dump, partly sacked, and some oxides had been screened. Samples assayed:—

(1.) Grab sample from small pile of "high-grade": Gold, 0.48 oz. per ton; silver, 0.1 oz. per ton.

(2.) Grab sample of oxides: Gold, 0.17 oz. per ton; silver, trace.

(3.) Grab sample from pile of oxidized rock and light mineral: Gold, 0.10 oz. per ton; silver, 0.1 oz. per ton.

(4.) Grab sample from sacked ore: Gold, 0.75 oz. per ton; silver, 0.05 oz. per ton.

Maybe. This claim is on the Kettle River Road, elevation 2,350 feet, on Crick (Trapper) Creek. It is part of a group of locations and Crown grants owned and leased by O. Berglund, of Rossland, and L. Cléry, of Westbridge. The principal showing is at an elevation of 2,600 feet, on the south side of the creek, in andesitic and dioritic rocks of the Wallace formation which are locally brecciated. There is a 20-foot adit and some stripping for 100 feet.

The vein-zone strikes nearly north and dips 50 degrees east; it is a band 20 to 24 inches wide of almost solid sulphide and a small amount of quartz, in addition to which the walls, particularly the foot-wall, contain lightly disseminated sulphide for several feet. The solid sulphide includes pyrrhotite, pyrite, arsenopyrite, sphalerite, and a little chalcopyrite. The pyrrhotite contains abundant rounded to irregular inclusions of quartz, and the suggested paragenesis is arsenopyrite and pyrite, pyrrhotite, sphalerite, chalcopyrite.

A loading-chute has been built to a road a few hundred feet long connecting with the river road, and several cars have been shipped to Tacoma smelter. The first two cars assayed:—

(1.) 40.2 tons: Gold, 0.7075 oz. per ton; silver, 1.12 oz. per ton; copper, 0.13 per cent.; zinc, 0.7 per cent.; arsenic, 2.22 per cent.; silica, 47.1 per cent.

(2.) 43.4 tons: Gold, 0.81 oz. per ton; silver, 0.84 oz. per ton; copper, 0.18 per cent.; zinc, 0.2 per cent.; arsenic, 1.58 per cent.; silica, 26.4 per cent.

Other mineralized showings on this claim are in zones of brecciation and alteration in the andesitic and dioritic rocks. The breccia consists of irregular fragments from several feet across down to a fraction of an inch. The rock has been altered to a dark greenish mass consisting of carbonate, epidote, actinolite, and chlorite, which in extreme cases is composed largely of actinolite and carbonate. Fragments of chert and cherty patches are common, so the rock has a mottled appearance. Mineralization by pyrite and locally also pyrrhotite occurs in the breccia and is restricted to the green alteration-product. Samples of this mineralization carried low values, or none, but the breccia-zones would seem to be worth prospecting.

Hard to Beat, Riverside, and Globe.

Noren and sons, of Westbridge, own a group flanking the river road, including the Crown-granted *Hard to Beat*, *Riverside*, and *Globe*, and extending to *Maybe* ground adjacent to Crick (Trapper) Creek. This ground, along the lower slopes of the valley-side, is underlain by rocks of the Wallace formation, including andesites, dioritic rocks, and cherty sediments, cut by dykes of which a common variety is a light-coloured porphyry, much altered but perhaps andesitic.

There are a number of showings on which a small amount of surface and near-surface work was done in former years. These are irregular mineral-zones which strike north-westward and dip rather steeply to the north-east. Vein-quartz is only in a few instances an important constituent of the zones, some of the mineralization contains a siliceous base and some is in rock without very strong alteration. Sulphides include pyrite and pyrrhotite, arsenopyrite, sphalerite, and chalcopyrite. None of these mineral zones has been traced for more than 200 feet, although elsewhere there are broad belts showing indications of mineralization that would seem to be much longer. Widths and amounts of mineralization are erratic, and it would appear that thorough surface prospecting should precede any underground work.

Other Claims.—On the *Jenny*, a located claim owned by Jack Carlson, of Rock Creek, just north-west of the *Bobbie Burns Fraction*, are two old 10-foot shafts and some recent open-cutting. These are in metamorphic rocks not far from quartz diorite; rocks to the north are sedimentary. The metamorphic rocks are cut by and impregnated with stringers and masses of fine magnetite accompanied by epidote. There is also a narrow quartzose vein mineralized with pyrite and a trace of arseno-pyrite; this appears to be a flat sheet at the surface, but is very irregular.

On the *Trapper*, leased by J. G. Creelman, of Greenwood, there are a number of old workings in Wallace formation rocks on the central and south-eastern part of the claim. Irregular zones, none of which has been traced any distance, strike northward and are mineralized with pyrite, pyrrhotite, and some chalcopyrite and arsenopyrite. On the northern part of the claim just above the creek is a breccia-zone, similar to those on the *Maybe*, but of unknown extent. Here one or more northward-striking stringers to quartz veins 10 inches wide are mineralized with pyrite and a little sphalerite and arsenopyrite.

Old workings are to be seen over much of the upper slopes of Horseshoe Mountain. These include open-cuts and shallow shafts, most of which are isolated and most of which are about 40 years old. They are on zones of fissuring, brecciation, and more or less alteration and silicification; they contain vein-quartz only locally and are mineralized with varying proportions of pyrite, pyrrhotite, and arsenopyrite. The sulphides occur in stringers, lenses, patches, and disseminations.

Similkameen River.

Copper Creek Section.

Copper Creek flows into Similkameen River 26 miles from Princeton on the Hope–Princeton Road, at an elevation of about 3,075 feet. The river flows in a steep-sided canyon from

the mouth of Pasayten River nearly to Princeton, with an open section half a mile in length at the mouth of Copper Creek. Timbered slopes rise from the canyon-edge to form the upland surface of the Interior Plateau. A prominent bench, level with the upper rim of the canyon and half a mile wide, extends from opposite and above Copper Creek to more than a mile below.

The rocks in the canyon in the neighbourhood of Copper Creek are correlated by Cairnes with the Tulameen series of Triassic age (Geological Survey, Canada, Summary Report, 1923, Part A). They comprise sedimentary and volcanic rocks with, in this vicinity, a regional strike of about north 15 degrees east and vertical dip. There are two dominant types of volcanics, a dark green augite andesite porphyry and a light green to greyish andesite porphyry, both of which are strongly altered, although in hand specimen they appear comparatively fresh. Many of the volcanic types are fragmental; both flow breccias, and breccias with rounded fragments that grade into sedimentary materials. The true sediments are slaty argillites. These rocks are covered west of and above the river by andesitic to basaltic lavas of Tertiary age.

Some placer-gold has been taken from this section of the river, but no mineral-deposits had been found until, in the fall of 1937, high assays were obtained from a narrow vein at water's edge. Before snow was gone in the spring some thirty claims had been staked, but few additional discoveries have since been made.

Silver Moon. This group of eleven claims and fractions is owned by E. N. Freding and Alex Wagenstein, of Princeton. It was optioned during the year by Kelowna Exploration Company, Limited, and after considerable surface work was done the option was relinquished. A lease was granted to five men late in the year who made a small shipment of high-grade gold ore.

The group covers the original discovery and extends from 400 feet below the mouth of Copper Creek for a mile down-stream. The rocks in the upper end of the canyon include a little slaty argillite but are principally volcanic types, many of which are fragmental. They are cut by shear-zones and by many stringers of quartz or quartz and calcite. The shear-zones are from a few inches to several feet in width and are bands of schist, more or less pyritized and containing locally quartz stringers; tighter and narrower sections may pass into narrow veins. The stringers form a prominent set with a strike of north 70 degrees west and a dip of 60 degrees north-eastward; they are from a fraction of an inch to a foot wide and from a few feet to a few tens of feet in length; they consist of quartz or quartz and calcite, frozen to the walls and commonly barren. Stringers of this set, when close together, form sheeted zones. A second set, striking north 30 degrees west, and with steep dips to the south-west, is not prominent. A third set, of rare occurrence, is almost flat; these stringers are locally mineralized with arsenopyrite and very small amounts of sphalerite, galena, chalcopyrite, and pyrite.

The showings on which work has been done are in the uppermost 800 feet of canyon, close to water's edge and to 100 feet above it. Irregular, branching, and reticulating shear-zones strike roughly north and are vertical; they form two or three principal zones up to 15 feet wide over an exposed width across the river of 160 feet. Many cross-stringers are seen, striking north 70 degrees west and dipping 60 degrees north-eastward; these, with rare exceptions, are barren. Five flat quartz and calcite stringers, to a maximum local width of 16 inches and one with variable dip to the west, have indicated lengths of a few feet to a few tens of feet, and are mineralized, locally, with massive arsenopyrite or with trains of arsenopyrite grains, and a little of the same mineral is seen in or close to slightly schistose walls.

Assays from open-cuts on the shear-zones show them to carry merely traces of gold or none. Of all the cross-stringers exposed naturally or by stripping only one was seen to carry a few specks of free gold; sulphides are rare to absent and values negligible. Exceedingly high assays have been obtained by reliable individuals from the better-mineralized portions of the flat stringers. Three samples taken by the writer assayed: Gold, *nil;* gold, 0.18 oz. per ton; silver, trace; gold, 32.76 oz. per ton; silver, 9.0 oz. per ton.

The highest-grade material consists of massive arsenopyrite fractured and traversed by tiny veinlets of quartz and carbonate. Careful scrutiny with a hand lens frequently discloses tiny specks of gold, some of which are visible to the naked eye. Microscopic examination

suggests that the gold is later than the arsenopyrite, and shows that the gold has a tendency to occur (in sizes to less than 10 microns) in elongate forms aligned on fractures and along arsenopyrite-crystal boundaries. The gold seen in one cross-stringer was isolated in quartz.

Gold-bearing sulphides appear to be restricted to the flattish stringers, and these are not numerous. Although most shear-zones are pyritized they do not appear to carry more than traces in gold.

Ground has been staked for a mile up-river from the *Silver Moon by* Alex. Broomfield, J. W. Gallagher and others, of Princeton and Hedley. The rock in the canyon section is principally light-coloured andesite porphyry, massive to fragmental. There is much less evidence there than below of pattern in shearing and cross-veining. Several shear-zones a few inches to 2 feet in width strike nearly north and are vertical or dip eastward; these contain locally stringers and lenses up to 1 foot wide of quartz and calcite. There are cross-stringers which strike about north 70 degrees west but they are not abundant; one relatively flat shear-zone was seen.

Mineralization is very scanty, although pyrite, arsenopyrite, sphalerite, chalcopyrite, and galena can be seen locally.

Roche River Section.

(*See* Annual Reports of the Minister of Mines, British Columbia, 1901, 1927, 1928. C. E. Cairnes, Geological Survey, Canada, Summary Report, 1923, Part A.)

Red Star.

This group of six claims, of which the *Anaconda* and *Red Star* are Crown-granted, is owned by Charles Bonnivier and Gus Pouwels, of Princeton. The group is on the Hope–Princeton Highway on the north side of Roche River, nearly 2 miles above the mouth of Pasayten River. A prominent flat, elevation about 3,325 feet, is flanked by a hillside sloping at 25 degrees to a flat summit 800 feet higher.

The rocks are part of the Tulameen series which are in this section represented by a schistose-band some 3 miles wide. They are dominantly of sedimentary origin, according to Cairnes, and include light-coloured quartz-sericite schists and greenish talcose and chloritic schists. The average strike is north 15 degrees west and the dip is between 45 and 60 degrees westward. They are poorly exposed on this ground, but there is a band of pyritic mineralization indicated, following the strike, that is perhaps 1,000 feet wide.

There are a number of adits on this property and several open-cuts, but the older workings are largely caved, so that a full examination is impossible. A long adit has been driven from the edge of the flat in an effort to tap at depth mineralization in an adit 480 feet higher in elevation. The upper adit, said to be 250 feet long and driven parallel to the formation, is accessible only for 63 feet in a direction of north 18 degrees west. Near the portal is a raise from another adit 100 feet lower and said to be 415 feet long. Mineralization, apparently parallel to the schistosity, consists of pyrite and a band 8 to 16 inches wide or more also contains considerable chalcopyrite and sphalerite. A sample of heavy sulphide chunks from the dump assayed: Gold, 0.06 oz. per ton; silver, 7.3 oz. per ton; copper, 17.0 per cent.; zinc, 4.0 per cent. A grab sample of heavy sulphides from the next lower dump assayed: Gold, 0.14 oz. per ton; silver, 5.7 oz. per ton; copper, 19.0 per cent.; zinc, 2.5 per cent.

The lowest adit is 1,090 feet long, it is small and sinuous, and work on it has been given up in recent years on account of the lack of ventilation. It is driven in the direction of the upper adit 140 feet at north 60 degrees west and then in an average direction of south 77 degrees west for 950 feet. The line of the adit crosses the projected line (south 18 degrees east) of the upper adit 600 feet to the south of the upper portal, and the face is 330 feet beyond, according to a compass survey. A drift 480 feet from the portal is 65 feet long in a direction of north 52 degrees west.

The rocks throughout are schists, with a strike of north 15 to 20 degrees west; dips are 40 degrees westward at the portal, about 55 degrees throughout most of the length, and 45 degrees westward at the face of the adit. At the drift the rocks are more highly schistose for a distance of about 40 feet, including a few steeply-dipping planes of strong shearing, and mineralization in this section consists of disseminated pyrite, chalcopyrite, and sphalerite. Three samples across a width of 11 feet of mineralization assayed traces in gold, 1 oz. or less in silver, and less than 1 per cent. copper. Two other weaker zones of mineralization are crossed 360 and 460 feet past the drift. Quartz is only locally present, commonly as unmineralized kidneys in the schists.

Assuming that the mineralization in the upper adit occurs strictly parallel to the schists, then the lower adit is close to that horizon. If the strike does not vary and the average dip is 45 degrees, then the lower adit is, according to rough calculation, about 140 feet short of its objective, but projection over such distances on both strike and dip is not satisfactory unless the geology is fully understood. A. F. Tigert, of Princeton, had recently commenced clearing out the upper adit in order to examine the mineral-zone, but only the first 63 feet was accessible at the time of the writer's visit in October.

There are a few other old properties in this section, on which little has been done in recent years. High values in gold are reported to have been obtained locally across narrow widths.

PLACER-GOLD DEPOSITS.

Rock Creek Area.

References.—Annual Reports of the Minister of Mines, British Columbia, 1930 to 1935, inclusive; Index to Annual Reports of the Minister of Mines, British Columbia, 1874–1936, for older, short references; W. E. Cockfield, Geological Survey, Canada, Memoir 179, 1935; C. E. Cairnes, Geological Survey, Canada, "Mineral Deposits of the West Half of Kettle River Area," Preliminary Report, 1937.

Introduction.—Rock Creek flows into Kettle River near the International boundary in Central British Columbia. The main creek heads south of the boundary and the two largest tributaries, McKinney and Jolly Creeks, head on the southern and south-eastern slopes of Baldy Mountain. The area is well served by highways and branch roads, Rock Creek station on the Kettle Valley Railway is close to the mouth of Rock Creek, and the high-tension line of the West Kootenay Power and Light Company, Limited, crosses the area.

The country has been burned over. From the main forks, through the basin of McKinney Creek, west of Jolly Creek Valley, and to the north and west, there is very little green timber left. The climate is one of light precipitation.

Rock Creek drainage was in early days the scene of considerable placer activity. The first discovery was made in 1860 and by 1900 work had almost died out. There was a revival of interest in the upper sections from 1930 to 1935, when interest again waned. The present report is an attempt not so much to point out sections of the creeks where pay-gravel may be found, but is rather an attempt to outline the geology of the area so that generalities may be made of use to placer-men in the district.

The area is part of the Interior Plateaux system, with elevations ranging between 3,000 and 4,500 feet. The ground rises to higher elevations to the north, culminating in Baldy Mountain, elevation 7,558 feet. Kettle River Valley is a broad trench cut into the plateau with an elevation, at Rock Creek station, of 1,978 feet.

The main streams flow in rather narrow valleys, 500 to 1,000 feet deep, in which there are canyon sections; Lower Rock Creek, for its entire length, flows in a steep-sided canyon about 400 feet in depth. The country is neither rugged nor very steep, except north-east of Jolly Creek, and much is a region of low slopes and gravel-covered stretches.

History.—Gold was first mined on Rock Creek in 1860. In that year a census showed 123 persons, and in the next year the Gold Commissioner reported between seventy-five and a hundred men working on the creek. Activity soon waned, and it seems that many men pushed on in search of new fields. The earliest diggings were not phenomenally rich and recovery on the average was about $4 per man per day.

Production figures are very incomplete and it is impossible to obtain an estimate of total recovery from the creek for any period. A report by the Gold Commissioner in 1861 states the known recovery for six months of 1860 to be $83,000. In the early nineties the recovery was several thousand dollars per year.

The history of the creek seems to be that from the earliest discovery there ensued a period of two or three years of intensive mining, following which there was a smaller amount of activity which became more sporadic with passing years. Activity seems to have subsided by the year 1900. Some Chinese were still working in 1903 but most white men had given up, and in 1901 it was stated that the Chinese were "making a small annual output, scarcely amounting to wages."

From 1900 to 1930 only occasional mention is made of the creek, and that referring only to the desultory efforts of a few individuals. From 1924 to 1930 no recovery of placer gold

was reported from Greenwood Mining Division, and in 1931 only 6 ounces. Recovery for the division jumped the next year, when the price of gold advanced.

In 1932 work was done by lessees of Rock Creek Consolidated Placers, Limited, at and near the "Williams" pit, where drifts were put in on a rock rim above the creek-bed, and in the same year work was resumed immediately below the *Old England* mineral claim. During the next year testing was done on Jolly Creek, both above and below the highway crossing, and several men were engaged in working McKinney Creek, near the mouth of Rice Creek, and a short distance below.

In 1934 Rock Creek Consolidated Placers, Limited, a holding company of Penticton and Greenwood, optioned their holdings to Porter and Condit, of Seattle, who did ditching and test-pitting on Jolly Creek above the main road crossing. Further work was done by Lynch Brothers, of Seattle, below the road. On McKinney Creek, M. D. Kinney hydraulicked with pump and engine. At the mouth of Rock Creek, Porter and Condit staked and optioned ground for several miles; a hydraulic pit was worked by these people during the summer of 1935 and was abandoned in 1936.

In 1938 little work was going on. V. J. Melsted was drift-mining on bed-rock below the uppermost canyon for the second season, on ground optioned from Jolly Creek Placers, a local syndicate, and a few individuals were at work on other parts of Jolly and McKinney Creeks.

Geology.—The bed-rock geology of the area is covered by the reports (noted above) of Cockfield and Cairnes, to which nothing need here be added.

There is, at least at lower elevations within the area, no evidence of glacial erosion, but there is abundant evidence of the effects of glaciation in deposits of drift, moraines, stream terraces, and dislocation of the pre-Glacial drainage. Glaciation and stream history are closely linked and both have affected the formation of placers.

The southern and eastern slopes of Baldy Mountain have been heavily glaciated; there are few rock-outcrops, and the country is more or less thickly covered with glacial drift. Morainal ridges are seen to lie parallel to lower Wapiti and Stanhope Creeks, roughly in a north-south direction, and irregular accumulations of drift are abundant.

Upper Jolly Creek is plainly poorly fitted to the topography. Above the uppermost road crossing the creek possesses no marked valley, but flows in a broad trench covered with drift. Immediately below the upper bridge the creek plunges into a canyon, swings in a bend northward, and then round to the south into the main valley. South and south-east of this upper canyon is a poorly-drained area of very low relief, several square miles in extent; it is covered with irregular accumulations of morainal materials, at a general elevation of approximately 3,740 feet. The character of this ground and the evidence of minor terrace remnants points to the fact that, following glaciation, Jolly Creek flowed sluggishly across it in a meandering course and then dropped fairly rapidly to lower drift-covered ground to the north. The meanders became incised in rock in the present canyon, which is cut to a depth of about 200 feet.

At the mouth of the canyon the rock walls end abruptly just south of the placer-workings, elevation 3,375 feet. The creek half a mile farther north then enters a second canyon through which it drops rapidly in a semi-circle to the east and south-east. West and north-west of this second canyon, at a general elevation of 3,565 feet, is an area of typical drift accumulation containing many kettle-holes. This material seems plainly to have blocked the former Stanhope Creek, which now flows southward between morainal ridges and then swings sharply to the east through a small canyon to the southern end of Little Conkle Lake.

The course of upper Jolly Creek is incised in a heavily glaciated topography and bears no relation to the pre-Glacial drainage pattern. The ancient stream-channel is plainly at right angles to the present stream just north of the upper canyon. The old valley above this point is vaguely indicated for a quarter of a mile by an irregular depression in which there is a small and periodic flow of water. It trends eastward through a gravel ridge to meet the main valley, but the exact point of outlet is uncertain. From its exposed portion in the placer-diggings the pre-Glacial stream must have flowed eastward and not south-east or south, because the distribution of rock-outcrops disproves the possibility of such a course.

The main Jolly Creek Valley from Little Conkle Lake to its confluence with McKinney Creek trends north. The valley itself continues northward past Conkle Lake, with only

minor deflections, and it has the appearance of being an ancient topographic feature, perhaps originated by faulting. Although the valley trends north and is comparatively straight, it has not been scoured out by glacial action. There is an upper canyon section, and others such as that at the crossing of the West Kootenay power-line, which could not have persisted had the valley been filled with an active glacier. Whether or not the valley was filled with stagnant ice seems a matter of little importance, although this was likely the case.

McKinney Creek flows in a pre-Glacial valley, broad and open in the upper stretches and narrow in the lowest 2 miles. The bed has been deepened in this latter section and a new course has been cut at the confluence with Jolly Creek. Both these streams have deserted their former courses and, before and after flowing together, have cut a deep and steep-walled canyon just at the entrance to Rock Creek Valley. Rock Creek, from this point to the mouth, flows in an even deeper canyon, but this cannot have been carved post-Glacially because there is no other possible outlet for the pre-Glacial drainage.

There has been post-Glacial deepening of the stream-channels, but it is difficult to measure the amount accurately because of the uncertainty of the exact position of pre-Glacial bed-rock. The amount of deepening is thought to be of the order of 40 feet.

The ground at and near the junction of Rock (Baker) Creek and the combined Jolly and McKinney Creeks was a gathering-ground of ice, from which the topography allowed no ready escape. Consequently, this general area became a site of ponding and morainal accumulation with more or less stratification in local bodies of water. This general section of Rock Creek and also the valleys of McKinney and Jolly Creeks are marked by terraces to heights of 300 feet above the present stream.

The terraces possess a gradient in the direction of, and nearly parallel with, the present streams. The question of the origin, nature of material, and manner of formation of these terraces is not an easy one to answer, but it is believed that many of them represent levelled-off or worked-over accumulations of glacial drift. The creek-valleys were choked and filled with gravels and boulder-clay to a depth of some 300 feet and the subsequent streams filled in inequalities in this general surface and doubtless planed off irregularities, with more or less reassortment of material. The streams gradually deepened and cut down into the morainal materials, leaving high terrace levels.

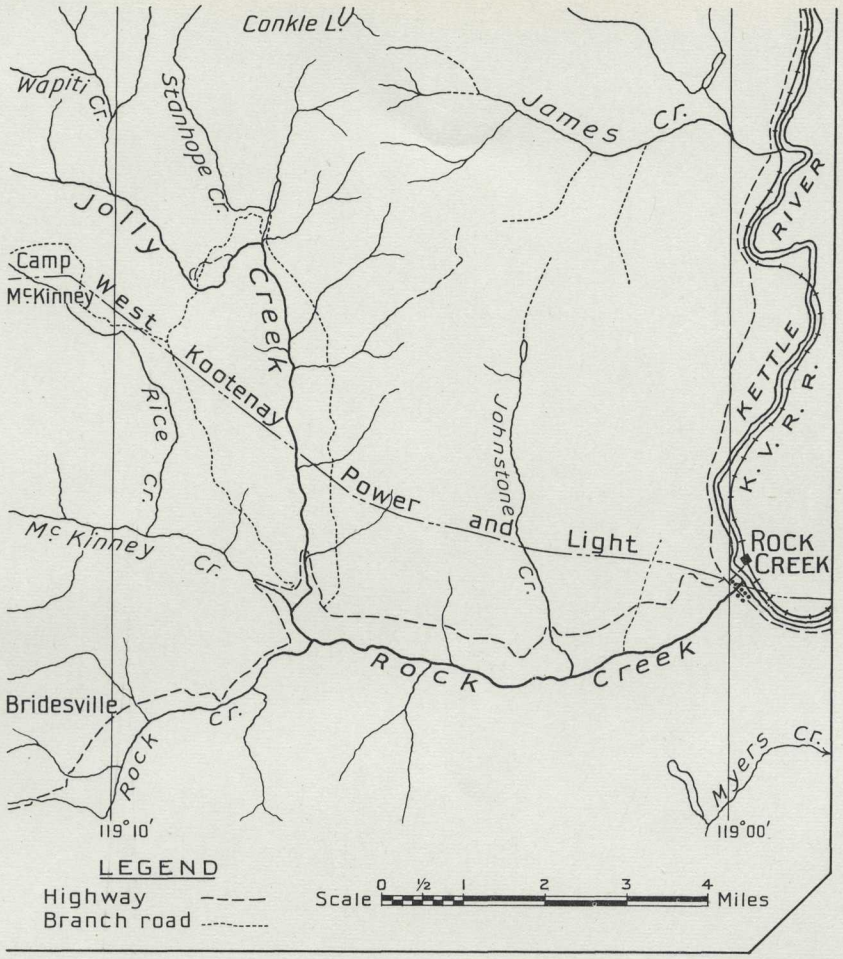
The post-Glacial streams follow almost precisely the ancient valleys, and have, with noted exceptions, reincised their former beds through deep fillings of glacial gravels and drift. Terraces have been formed, and rock rims and benches have locally been left as (possibly) remnants of the former beds.

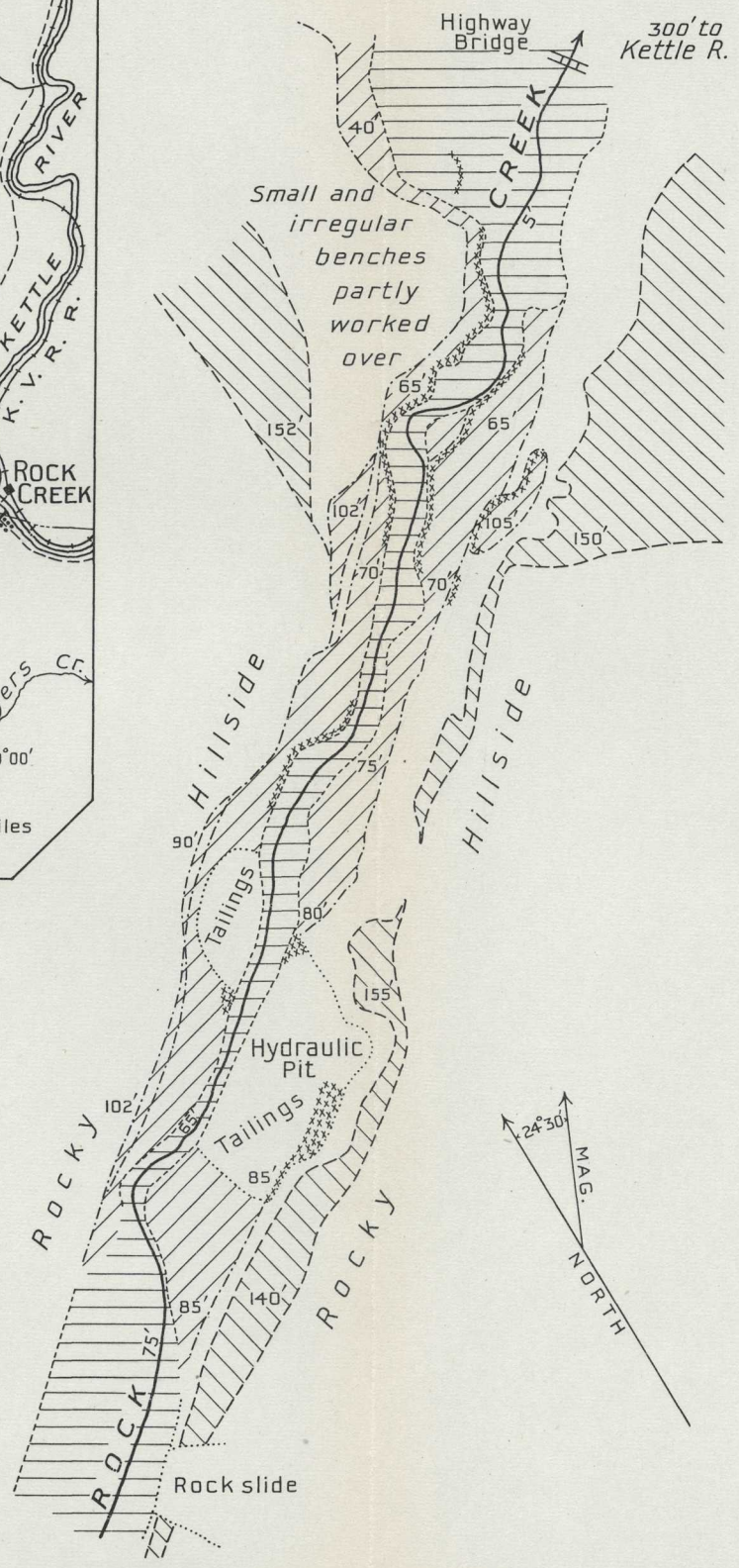
Gravels in the stream-beds are coarse, and boulders are encountered measuring 6 feet and more across. A higher proportion of granitic boulders is found than would now find its way into the present streams, and consequently it appears that many of these have been transported from granitic areas during glacial time. Gravels on bed-rock rims and benches are seen, notably at the "Williams" pit and at the "Melsted" workings on Jolly Creek, to include numbers of decomposed pebbles and boulders, some of which can be broken in the hand. Fine silt or "slum" is reported to be of widespread occurrence and to hamper considerably workings in or close to the present stream-beds.

Gold has been recovered from a few chief sections: Rock Creek at the mouth, McKinney Creek below Rice Creek, Jolly Creek at White and Denver bars, and Jolly Creek below the uppermost canyon north of the *Old England* mineral claim. Of these sections the first was the greatest producer. Other intervening sections produced some gold but in much less quantity.

With the exception of the uppermost diggings on Jolly Creek, where the creek-bed was once worked over, production has come from rock rims and benches above or close to water-level. Shafts have been sunk and ditches dug to bed-rock in a number of places, but the actual stream-beds appear to have been worked in this one section only. Stream gradients are low (2 per cent. on Jolly Creek) so that drainage is difficult and disposal of tailings not easy, and this seems in part to have deterred exploration.

Lower Rock Creek.—Lower Rock Creek is the site of the earliest diggings in the district. These workings extend up-stream for about a mile above the highway bridge, and the accompanying plane-table map is of the lower 3,800 feet of this distance. It is not known





LEGEND

Present creek bed 2-10' above stream level

Terrace and bench remnants

Highest (main) terrace level part of Kettle River system

Bedrock rim and outcrop

Elevation above highway bridge 65'

Scale 200 0 200 400 600 800 Feet

Map of Lower Rock Creek. The site of the earliest and principal placer-workings on the creek. Insert map shows the main Rock Creek drainage.

how much, if any, of the actual creek-bed was here worked, but all ground in the valley lateral to the bed of the present stream seems to have been worked over.

The creek flows in a canyon about 400 feet wide, with rocky sides sloping at from moderate to steep angles. A prominent terrace, about 150 feet in elevation above the highway bridge, is nearly level, and is composed of well-stratified gravels. It is a part of the Kettle River terrace system, locally several hundred feet wide, but in the Rock Creek Valley it exists as a narrow remnant on the eastern side only.

A former level of the creek-bottom forms a prominent bed-rock bench on both sides of the creek at least as far as the hydraulic pit. The bench has been entirely worked over, and from it the greater part of the recovery from this section has come. The grade is about 1 per cent., and into it the present creek has carved a canyon 15 to 50 feet deep to stream-level. The stream gradient is about 2½ per cent., and the depth of gravels in the present bed is not known. Two small, worked-over bench-remnants, elevation 102 and 105 feet above the bridge, are seen on either side at the throat of the valley, and to the north-west, round on to the Kettle River slope, is a series of irregular and discontinuous gravel benches which have been largely worked over.

Southward from the mapped section the bed-rock bench is not seen, but it is very likely closer to the surface than is the present stream-bed. The ground has been worked over as far as a prominent gully on the eastern side, and there remains evidence that the creek was at one time diverted.

The only sections of ground remaining are two narrow rims on the western side, opposite the hydraulic pit, 90 and 102 feet in elevation above the bridge. They have been partly worked over and one short irregular drift has been driven in recent years.

The hydraulic pit was operated by Porter and Condit in 1935 and for a short time in 1936; water was brought from a penstock about 3 miles up the creek. The amount of gravels moved is not known, but it would appear that 100,000 yards is a fair estimate. Difficulty was encountered in disposing of the tailings, and work was abandoned when values were found to be low. It is reported that sluicing of the high-level terrace disclosed old-time drifts at its base on bed-rock.

Melsted Workings.—These are drift workings on the west side of Jolly Creek just below the uppermost canyon, where a former channel is crossed by the present stream nearly at right angles. This is an area of former diggings, the highest on the creek, in which the bed of the creek was turned over and drifts were driven into the banks on both sides.

A bed-rock floor is indicated to be about 800 feet wide at about the level of the present stream. Gravels, including boulders up to 4 feet across, are poorly shingled and include a small amount of sand and pea gravel; they are sufficiently cemented by clayey material that excavation is difficult and systematic timbering unnecessary. This has the appearance of being a stream-channel quickly filled by unassorted, coarse gravels. Bed-rock is commonly weathered as are many boulders, although some boulders are unweathered. Flat gold, 870 to 875 fine, is found in a pay-streak not more than 15 inches thick and commonly right on bed-rock; the pay-streak follows a sinuous course averaging south 56 degrees west and is 10 to 20 feet wide. Values are reported to vary in the pay-streak between 50 cents and $3 per square foot of bed-rock. Excavation is by pressure-hose supplemented by blasting. A crew of two to four men has been employed by V. J. Melsted for two seasons.

The pay is restricted to a surprisingly narrow streak, considering the apparent width of the channel and the evidence that it was choked with very coarse gravels. The pay has been followed for a distance of some 350 feet. The apparent width of channel is much greater than that common to the district, but it may in part be due to softer (serpentine) bed-rock than found elsewhere. Another explanation, not proved, is that formerly Stanhope Creek here flowed into Jolly Creek, instead of near Little Conkle Lake as at present.

Former attempts to drift on this channel down-grade to the east were stopped by water. The outlet on the main Jolly Creek end has not been located, but it is likely to be almost directly across the intervening gravel ridge.

Scattered workings are to be found through the next canyon to the main north-south valley, and at the forks, elevation 3,250 feet, a bar about 10 to 15 feet above the creek has been worked over.

Mid-section of Jolly Creek.—This section was mapped by plane-table for 8,000 feet north of the crossing of the West Kootenay Power and Light Company's high-tension line. It is a section including Denver bar, one of the richest diggings on the creek. The grade of the creek is about 2 per cent.

The most prominent feature of the valley is the high-terrace level which, although incised by many dry gullies, is well-defined throughout on the eastern bank; it is represented on the western bank by one or two remnants. The terrace has a definite gradient to the south which is slightly steeper than that of the present creek. It is at an elevation of 300 feet or so above the creek at the north end and 270 feet above at the south end of the map; it is about 250 feet above the creek abreast of the main highway bridge. There are sub-terraces on the west bank, but none on the east bank.

The character of material making up this terrace is difficult to determine. Only between the two tributaries from the east, where a drift has been put in at a high level, can the material be studied. At this point it is glacial drift, i.e., fine boulder-clay. In other places on small banks it appears to be stratified gravel, but without adequate sections exposed it is very difficult to identify the character of material, and some resorting of the banks by the present streams can easily have occurred.

The creek flows through a canyon at the north and south ends of this section, over the remainder of which bed-rock is only locally exposed. Bed-rock is believed to be very near the surface on the western hillside throughout, and at the lower canyon it is continuous to the east to the main hillside. Through the remainder of the eastern valley-side bed-rock is exposed low down near the "Bennett" drift, on the road above the "Williams" pit, in the first tributary from the east, and in a high rock point north of the second tributary. In the valley-bottom bed-rock is exposed as mapped, forming rims and rock benches from near stream-level to 60 feet above.

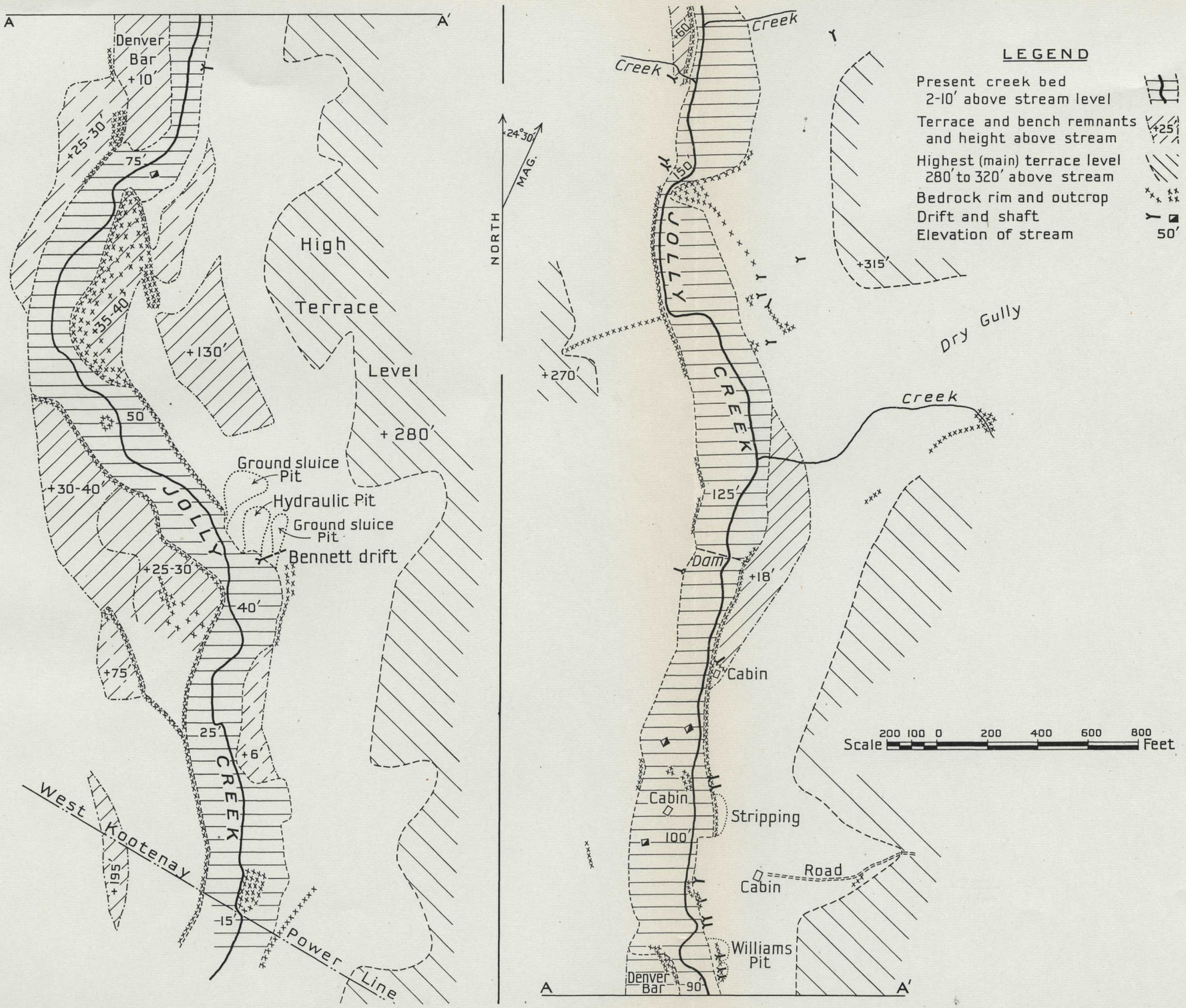
At the extreme north end of the map, on the west side, is a rock bench 60 feet above stream-level. On the east side, just below the southern tributary from the east, is a rock bench about 18 feet above stream-level, and this bench is apparently continuous with a poorly-exposed rock rim some 25 feet above stream-level just north of the road. Definite outcrops are lacking, but this rim appears to continue to the "Williams" pit. Rock is seen at a comparable elevation immediately south of Denver bar on the west side, in a rock bench below and on the east, and again on the west side of the creek to below the "Bennett" drift.

Bed-rock outcrops nearly at stream-level at Denver bar, 700 feet north of Denver bar, and at the "Bennett" drift, at elevations 5 to 15 feet above stream-level; whether or not this represents a second low-level rock rim or bench it is hard to say.

Denver bar, elevation 2,980 feet, was one of the richest diggings on the creek, and from it it is reported $80,000 was taken. It is a rock platform without apparent continuation, some 10 feet above stream-level. The somewhat higher rock point immediately to the south-west has been carefully worked over, and so has the irregular rock bench to the south on the east side of the stream. Other workings to the south, on both sides of the creek, seem to be more haphazard, as if the diggings were not very productive, but it is difficult at this day to tell.

The old-timers seem to have missed, or ignored, the rock rim at "Williams" pit and for several hundred feet up-stream. A number of drifts have been run on this rim, which is said to slope flatly to the east. At the "Williams" pit a semi-circular drift system was later hydraulicked by engine and pump, and it is believed fair values were obtained on bed-rock, although increasing height of bank limits the scope of this method of mining. Reports are conflicting, but it seems certain that the best values found in this section came from cracks within the bed-rock. The rim is apparently continuous, at a flatter grade than the present creek, with the rock bench that extends to the tributary from the east. This bench is thinly covered with gravels and has the appearance of having been carefully tested but not having been worked.

The definite correlation of the "Williams" rim and bench with the rock benches at comparable elevations down-stream or with the rock bench on which the "Bennett" drift is driven is a matter of speculation only. The "Williams" rim may mark the pre-Glacial channel, and in support of this is the fact that much of the gravel is deeply weathered, as exposed in the hydraulic pit.



Map of a part of Jolly Creek, north of West Kootenay Power and Light Company's high-tension line.

The " Bennett " drift is said to be cut into bed-rock and to be about 200 feet in length. No definite idea of the gold content of the gravels is obtainable; bed-rock seems to have been quite level here, and the lowest gravels contained a good deal of silt which hampered working and necessitated the driving within bed-rock. Ground-sluicing and hydraulicking have demonstrated that the upper gravels do not contain much gold.

Shafts have been sunk to bed-rock close to the present stream-bed and, according to report, prove a depth of 20 and more feet of gravels. Water is of course a serious problem in such work, and although it is impossible to tell what values were found in these shafts, it seems definite that the present valley-bottom to bed-rock has never been fully tested.

A number of drifts have been driven into the east bank between the two tributaries, apparently in search of the continuation of the " Williams " rim-rock. Drifts on the west side, to the north, were efforts to prove the existence of a buried channel extending from the present " Melsted " workings.

To sum up, in this section of the creek Denver bar was the only rich diggings of early days, and other rock rims and benches have been worked over or tested leaving, in the opinion of the writer, only one possibility for a completely unexplored section in a straight line between Denver bar and the " Bennett " drift. The creek-bottom has never been worked. In workings on rim-rock most gold has been found on the actual rim and values appear to be less with distance from the creek. It seems, from all available reports, that in bed-rock workings of recent years the greater amount of gold has been found in crevices in bed-rock and that smooth bed-rock has little gold on it.

The fact that gold has been found in this section of the creek and not above for some distance has been argued by some as proof that the gold came in from a lateral, now buried channel. The writer sees a possibility for such a former tributary of the old valley in about the position of the dry gully which trends north-eastward, but he is hesitant to believe that the gold did come in from a tributary. The creek above, for a distance of 1½ miles, flows through a canyon in which whatever gold there is is likely to be found on bed-rock beneath the present stream.

McKinney Creek.—McKinney Creek flows eastward through a broader and more open valley than do the other streams; it heads on the southern slopes of Baldy Mountain. The valley has two prominent terrace levels at elevations of about 170 and 280 feet above the creek; the lower of these is continuous with the main terrace on Jolly Creek and the higher is found only in rare remnants on the west side of Jolly Creek.

The diggings on McKinney Creek were never so profitable as on Jolly Creek, and most of the workings are restricted to the lower 5,000 feet above the highway bridge. In this distance the creek flows through a narrow and shallow canyon carved in the bed of a former level of the stream. At the upper end of this stretch bed-rock nearly coincides with stream-level and in the lower 2,000 feet bed-rock is 20 to 40 feet above the stream. Old workings on this bed-rock bench extend above the road for 1,500 feet, where it is covered by a low terrace remnant once hydraulicked by M. D. Kinney.

Nearly a mile above the road are old workings on a bench on the south side 10 to 20 feet above creek-level which is said to have contained good pay. Here F. W. Winser was engaged, in 1938, in stripping to bed-rock on the north margin of the creek through 12 feet of gravels. He reports the pay to be 4 feet thick on bed-rock, associated with considerable fine silt. He reports also that he encounters local masses of boulder-clay in the valley-bottom; these were not seen by the writer.

Above these diggings, 100 yards, the creek flows in a canyon 50 feet wide with rims 10 to 15 feet high, and for about 1,000 feet up-stream there is evidence of old workings, none of which is extensive. Bed-rock shows locally along this stretch to the mouth of Rice Creek, where McKinney Creek flows in a short narrow canyon, and immediately above is Kirby's bar, worked in 1932 and for two succeeding seasons. Here bed-rock was cleaned at about 3 feet below stream-level for 200 by 100 feet; gravel, including boulders to 6 feet across, is some 10 feet deep. The creek canyon is a post-Glacial channel and Rice Creek does not, apparently, follow its original bed. This seems to be the upper limit of workings on McKinney Creek.

The " Kinney " pit, hydraulicked in recent years, represents an excavation of about 3,000 yards. It was worked to a maximum depth of 20 feet to a hard clay layer about 2 feet thick. A shaft was sunk 13 feet deep in the pit to within about 7 feet of present creek-level, and in

this shaft bones were found in clean gravels near bed-rock, but no gold. The bones are said to be of a Tertiary mammal, but this point cannot be definitely checked.

Recoveries from McKinney Creek in more recent years have not been startling, although it is believed a few have made wages. It is reported that stream-gravels in the southern section near the bridge have been found in one shaft to be 28 feet deep; this would appear to be a low spot, and no gold is reported.

The present stream seems to follow very closely the former bed, into which narrow canyon-gutters have been cut. Not all of the rim-rock has been worked although considerable seems to have at one time been tested, and it may be that a few corners may repay individual effort.

Other Localities on Jolly Creek.—White's bar, a former rich diggings, about half-way between the power-line crossing and the highway, has all been worked over. It is a bed-rock bench 15 to 20 feet above stream-level, originally covered by about 15 feet of gravels. A gravel terrace-level is some 50 feet above the rock bench. It is reported that gold from this bar had considerable associated quartz.

Raby's bar, about 2,000 feet above the highway bridge, is reported to have had some production. Shafts sunk by Porter and Condit showed, according to reports, 40 feet of gravel to bed-rock. An attempt was made by Porter and Condit to drain this ground, and an open ditch was dug by drag-line excavator for about 1,600 feet above the bridge, but an intervening high rim of bed-rock was encountered, so the attempt failed. Drainage had in former years been attempted by drifting.

Below the bridge and above the canyon there are old workings, but it is not certain how much ground has been turned over. In recent years excavating just above the canyon throat found, according to report, smooth bed-rock with very little gold on it. On the south side of the turn above the canyon a shaft has been sunk by C. C. Byers, of Rock Creek. The shaft is 21 feet deep to bed-rock, and from it Byers reports a drift 175 feet to the south, when water stopped the work. All evidence points to this being on the former channel of Jolly Creek, the southern end of which has not been located. Bed-rock in the shaft is at a comparable elevation with that of the creek and is likely higher. At 165 feet from the shaft bed-rock was not found 9 feet below the drift.

Workings in the canyon, just below the mouth of McKinney Creek, include a drift about 20 feet above creek level. This drift, now caved, is said by Joe Pringle, of Rock Creek, to have been productive, and he and others believe it to be on a former channel of McKinney Creek. There seems to be reasonable doubt of this latter point, because the canyon below has every appearance of being carved since the time of terrace formation, and if so the former McKinney Creek must have had a different outlet. Whether the two creeks once flowed side by side into Rock Creek or whether McKinney Creek first flowed into Jolly Creek, the writer cannot say.

Conclusions.—Not all workings have been described in this report, because it is difficult to describe and to assess the importance of old diggings. Old workings, with few exceptions, were on bed-rock higher than that of the present stream-channel. Work in recent years indicates that there is little gold on smooth bed-rock, and that the best values have been found on actual rims and within cracks on bed-rock.

There are two runs of gold in Jolly Creek, that in the Melsted workings being 870 to 875 fine and very flat, whereas that found lower down is about 830 fine and inclined to be "shotty."

On central Jolly Creek there does not seem to be good reason for the distribution of gold, and the writer does not believe that the known concentrations were made by local cross channels or that the gold in White's bar was brought down, except in slight part, with surface wash.

With the exception of the uppermost section of Jolly Creek, the stream-beds have not been worked. Shafts have been sunk at different points, but rumours of the findings in these shafts form an insufficient basis for evaluation of the present creek gravels. Gradients are low, about 2 per cent., so that drainage is difficult and pumping and tailings disposal would always be costly.

Rim-rock may still be found in a few places where not now evident and, if so, will have to be mined by drifting unless the overlying gravels are thin. There does not appear to be any ground suitable for hydraulicking.

Certainly the country is gold-bearing, as witness *Camp McKinney, Dayton Camp, Old England*, and other localities, and the source of the placer gold need be looked for no further than in these veins, and very likely in others not yet found. Of the factors of concentration of gold, local wash, reconcentrations from former channels, and grade and character of bed-rock, the latter appears to be extremely important and one not likely much changed throughout stream history.

SPECIAL REPORTS.

Typewritten copies at 25 cents each are available to those who specially request reports by R. J. Maconachie on the following properties:—

Wallachin Area: Vision Group, Coronation Group.

PROGRESS NOTES.

BY

JOHN G. BIGGS AND H. C. HUGHES.

LODE-GOLD DEPOSITS.

*Hedley Camp.**

Kelowna Exploration Co., Ltd.—W. C. Douglass, general manager; Floyd Turner, mine manager. This company operates the *Nickel Plate* mine, which is the most important gold-mining operation in the district. The concentrator, machine-shops, and general offices are near Hedley. The mine is at an elevation of 5,600 feet and approximately 4,000 feet above and 4 miles north of the town. Transportation up the side of the mountain is in two sections: a 10,000-foot gravity-tramway from the ore-bin at the mill is operated with skips having a capacity of 6 tons; from the central to the upper terminal it is run by electric motors chain-geared to friction and control wheels that maintain a constant speed during the whole of the operation.

The portal of the mine is 1½ miles north of the top terminal of the tramway and an electric-trolley motor system hauls the ore from the mine to the upper end of the tram.

An active programme of development has been conducted during the year, both in the *Nickel Plate* mine and in the Bulldog tunnel, the portal of which is some 3,000 feet south of the portal of the *Nickel Plate* mine.

This mine is directly connected with the *Hedley Mascot* mine at the No. 12 level, and as the portal of this mine is at a much higher elevation there is a good current of air passing which provides very satisfactory main ventilation for both mines.

There are 190 men employed at this mining operation, ninety men underground and 100 at the surface.

Hedley Mascot Gold Mines, Ltd.—C. W. S. Tremaine, general superintendent. This mine is 1 mile north of Hedley; the concentrator and mine offices are on the east bank of 20-Mile Creek and the camp is on the side of the mountain, 2,795 feet above the mill. The ore is transported down the side of the mountain by a "quad" haul-back aerial tramway, 5,600 feet in length, from the ore-bin at the mine to the mill. The two skips have a capacity of 3 tons each.

The mine has been developed by an 8- by 8-foot adit-tunnel 2,500 feet in length and generally known as the 4,800-foot level; this is the main haulage drift into the *Mascot Fraction*. The major developments are in ore-bodies above the main level. The ore is loaded at the chutes on the drift into self-dumping mine-cars and transported by storage-battery motors to the aerial-tram bins at the mine portal.

The workings of this mine are connected through to the workings of the adjacent *Nickel Plate* mine, and this connection provides excellent ventilation for both.

* By John G. Biggs.

During the year an active programme of development has taken place at this mine with a view to operating at greater depth by driving a lower tunnel, known as the 4,300-foot tunnel, at an elevation 500 feet lower than the present working-tunnel. At the end of the year this new tunnel had been driven 1,600 feet from the portal. Electric power for the mine is provided by the West Kootenay Power and Light Company, Limited. There were 103 men employed, forty-six underground and fifty-seven on the surface.

Canty Gold Mines (Hedley), Ltd.—Charles Bishop, superintendent. This new gold-mining operation is 2½ miles north-west of the *Nickel Plate* mine at Hedley, at an elevation of 6,000 feet, and is reached by a good mountain road from Hedley.

The sinking of the three-compartment (14.4 by 5 feet) vertical shaft was completed to the 427-foot level during the early part of the year and provides two skipways and a manway; ore-pockets were cut in the north side of the shaft at the 200-foot and the 400-foot levels respectively. Work was concentrated on drifting to the north on the 200-foot level, with a view to reaching an area previously explored by diamond-drilling. During the latter part of the year drifting was commenced on the 400-foot level on the north side of the shaft.

Diesel power is at present used at this mining operation and consists of three units. A large double-drum shaft hoist is operated directly by a Gardner power unit and runs two shaft skips provided with safety-catches. They have a capacity of 2 tons and are equipped with automatic skip-dumping arrangements in the head frame at the surface. An International Diesel unit operates a 75-k.v.a. generator and provides power for the mine-fan, machine-shop, and general lighting purposes. A large Ruston-Diesel engine provides power for the operation of a Gardner-Denver 2-stage air-compressor, having a capacity of 750 cubic feet of free air per minute, for the operation of the machine-drills and the steel-sharpener.

There were twenty-eight men employed at this mine.

*Osoyoos Lake Area.**

Osoyoos Mines, Ltd.—J. O. Howells, manager. This mine is in the Osoyoos district, 1½ miles north of the International Boundary. The camp buildings are in the valley, and the mining operations on the adjacent hill. This is a well-maintained camp; the accommodation for the employees consists of several detached small bunk-houses, a large modern wash- and change-room, mine offices, and a dining-room and kitchen.

During the present year mining operations have been concentrated on the *Dividend* mineral claim. They consisted mostly of open-cutting and glory-holing on a large ore-body with strong walls. The glory-hole is connected by raises to the drift on the same elevation as the ore-bin at the mill, to which the ore is trammed by hand. Preparations were also made for increasing the capacity of the concentrator by the installation of a new ball-mill and flotation cells. The tailings from the flotation-mill are further treated by a modern cyanide plant farther down the hill, which was installed during 1937. Power is supplied by the West Kootenay Power Company.

There were fifty men employed.

*Fairview Camp.**

Fairview Amalgamated Gold Mines, Ltd.—J. A. McKenzie, manager. This mine is 3 miles west of Oliver, and comprises the *Morning Star* and *Fairview* gold-mining operations. A 150-ton flotation-mill is situated at the *Morning Star* mine, at an elevation of 2,400 feet, and the mining operations are conducted at the *Fairview* mine, 2 miles south of the mill. The mine is at an elevation of 3,050 feet and the ore is transported from the mine-bunkers to the mill by motor-trucks.

The *Fairview* mine has been developed by a long adit known as No. 5 level, driven on the vein a distance of approximately 2,600 feet from the portal. At 1,000 feet from the portal a raise has been driven through to the surface for ventilation; a fan is installed at the foot of this raise and the air is conducted to the working-places by galvanized pipes. There has been some raising and stoping done on the inside of this drift, the most important being the "B" and "F" stopes.

With a view to developing the vein at greater depth, during the latter part of 1937 the No. 6 adit-drift, situated 1,200 feet north of the No. 5 and 135 feet below in elevation, was commenced. It intersected a large ore-body 850 feet from the portal. Ore-bunkers were

* By John G. Biggs.

installed near the portal of this drift, mining operations are being concentrated in this lower level and the operations in the No. 5 drift confined to the drawing of the loose ore from the stopes.

Power is provided by the West Kootenay Power and Light Company, Limited, and is used for the operation of the mill at the *Morning Star* and an air-compressor at the *Fairview*.

There were fifty men employed at this mine, twenty-six underground and twenty-four at the surface.

*Twin Lakes Area.**

Gold Standard Mining Co.—Joseph Wukelich, manager. This mining property is 24 miles south-west of Penticton and is reached by a good mountain road. Joseph Wukelich has a lease on the *Grandoro* gold mine which has been inactive for several years and is equipped with a good Diesel power plant, steel-sharpening shop, rock-drills, and other equipment necessary for mining operations. During the year most of the work has been done on the *King* mineral claim, situated 1,500 feet north of the *Grandoro* mine. Two small shafts, 30 feet deep, have been sunk on the ore and some drifting done from the surface at a lower elevation with a view to intersecting the ore at greater depth. A portable gasoline-driven air-compressor provides power for this work. The ore is sorted and shipped direct to the smelter.

There were seven men employed, four at the surface and three underground.

*Stump Lake Area.**

Consolidated Nicola Gold Fields, Ltd.—R. A. Petter, manager. This mining operation, formerly known as the *Nicola* mine, is 2 miles west of the Merritt–Kamloops Highway and 30 miles from Merritt. During the year work in this mine has been confined to the development of the *Enterprise* vein at depth. The 320 adit is the main entry and intersects the *Enterprise* vein 800 feet from the portal; a considerable amount of stoping has been done in the vein above this level. This vein has a general dip of 45 degrees and has been developed to the dip by an inclined shaft which during the year was extended to the 950-foot level. The 320-foot drift was extended and development conducted on the 400-, 550-, and 675-foot drifts. The vein was intersected in the 800- and 900-foot drifts. It is the policy of the present management to greatly extend the mine-development before the mill is again placed in operation.

There are thirty-seven men employed at this mine, eighteen underground and nineteen at the surface.

*North Thompson River Area.**

Windpass Gold Mining Co., Ltd.—Allan J. Smith, general manager; Bert Pearson, general superintendent. This mining operation is 5 miles north of Boulder, a flag-station on the Canadian National Railway. The mill and the power plant are at the foot of the mountain at the side of Dunn Lake, at an elevation of 1,825 feet, and the mine is at an elevation of 5,340 feet. The ore is transported from the mine to the mill by an aerial tramway 2½ miles in length; the top terminal of the tramway being located near the portal of the *Windpass* gold mine. This operation consists of two mines known as the *Windpass* and the *Sweet Home*. The *Windpass* is the larger and more important and constitutes the chief mining operation on the property. The *Sweet Home* is 2,500 feet south of the *Windpass* mine and 400 feet below in elevation. It is accessible by a wagon-road from the aerial tramway 4,000 feet below the top terminal where the ore-bin from *Sweet Home* is located. The ore is transported from the *Sweet Home* mine to this ore-bin by a large motor-truck, loaded into the tramway buckets at this bin, and transported to the mill.

The *Windpass* mine has been developed by an adit from which an inclined shaft was sunk 35 degrees to a depth of 900 feet.

During the year work was abandoned in the lower levels and concentrated on the pillars of the upper workings which are comparatively limited.

The *Sweet Home* mine has been developed by a 30-degree inclined shaft driven to the main adit which connects to the 450-foot drift in the foot-wall of the vein. Raises have been driven from the shaft into the vein. The No. 4 ore-pocket is near the foot of the shaft and the main developments are conducted on the Nos. 1, 3, and 4 drifts.

* By John G. Biggs.

Power for this operation consists of a 400-horse-power Diesel electric plant situated near the mill. It provides power and light for the mill and camp. A high-tension line carries the power to the transformers at the mine.

There were sixty-four men employed at this mine, thirty underground and thirty-four at the surface.

*Vernon Area.**

Kalamalka Mine.—James Penney, manager. This mine is south of the Vernon–Lumby Highway, 12 miles east of Vernon, and accessible by a good road; there are good camp buildings and large ore-bunkers. Power is provided by a Belliss and Marcom 2-stage air-compressor having a rating of 360 cubic feet of free air per minute and operated by a 120-horse-power Vivian-Diesel engine.

The mine has been developed by two adits. Some crosscutting, raising, and stoping has been done between these drifts. The ore has good fluxing qualities and is shipped direct to the smelter.

During the year the Penney and Heidler syndicate, comprising six miners from the Rossland district, leased this mine and commenced work during the early part of October with a view to further development and shipment of ore direct to the smelter.

Blue Hawk Mine.—R. A. Mowatt, manager. This mine is 15 miles north of Westbank on Okanagan Lake, and is accessible by a winding mountain road.

The work done is entirely exploratory with a view of proving a quartz-vein exposure. A crosscut had been driven a distance of approximately 500 feet when the vein was encountered and drifting is being continued on the vein.

A small air-compressor belt-driven by a gasoline-engine is in use at the mine for the operation of a drifter. There were five men employed, three underground and two at the surface.

Beaverdell Area.†

Midnight Group.—Situated 1¾ miles south of Beaverdell, just off the highway. Owned and operated by Wm. Youngson and associates, of Beaverdell. One man, employed spasmodically throughout the year, drove about 120 feet of tunnel. A shipment of 2 tons made to Trail returned 2 oz. in gold and 27 oz. in silver.

Kettle River Area.†

Barnato.—Situated on the North Fork of the Kettle River on Horseshoe Mountain, about 23 miles north of Westbridge. Owned by Mr. Reddan, of West Vancouver, and optioned to the Consolidated Mining and Smelting Company of Canada, Limited. The exploratory programme carried out included the removal of 14,763 cubic feet of material in surface-trenching and 1,959 feet of diamond-drilling.

Mogul.—Situated on Horseshoe Mountain, about 24 miles north of Westbridge. Operated under lease by C. and O. Sherdahl, of Westbridge. Two and four men were employed during the summer. A new blacksmith-shop was built near the portal of the low level working-adit. A total of 54 tons of ore, shipped to the Trail smelter, yielded 68 oz. of gold and 12 oz. of silver.

Maybe.—Situated on the main road up the North Fork of the Kettle River, 23 miles above Westbridge. Owned and operated by L. Clery and O. Berglund, of Westbridge. Four men worked, both on the surface and underground, at this property for the greater part of the year. The property was optioned to the Bayonne Consolidated Mines during the year after an examination made by that company. Development-work done by the owners included 120 feet of drifting. In addition a good cabin was built. Ore totalling 186 tons shipped to the Trail smelter yielded 148 oz. of gold and 207 oz. of silver.

Greenwood-Boundary Falls Area.†

Number 7.—Situated in Central Camp, near Boundary Falls. Owned by the Consolidated Mining and Smelting Company of Canada, Limited, and operated under lease by W. E. McArthur, of Greenwood. Four men were employed, with three underground, for several months in the year. Development included 200 feet of raising, 50 feet of sinking, and

* By John G. Biggs.

† By H. C. Hughes.

considerable surface-trenching; 2,453 tons of ore mined and shipped to the Trail smelter yielded 288 oz. of gold and 1,007 oz. of silver.

City of Paris.—Situated on Goosmus Creek, about 15 miles from Grand Forks and just north of the International boundary. Owned by Mrs. Margaret Johnson, of Los Angeles, and operated under lease by Celius Nelson and partners, of Grand Forks, B.C. Three men were employed underground; 138 tons of ore mined and shipped to Trail yielded 13 oz. of gold and 951 oz. of silver.

Crescent.—Situated 2 miles west of Phoenix. Owned by C. King and Mrs. Dukhamel, and operated under lease by E. McGillivary and the Kolinsky family, a total of four, all working underground. The first work done by hand-steel, but a portable gasoline-driven compressor was installed later in the year. A total of 27 tons of ore mined and shipped to Trail yielded 7 oz. of gold and 1,297 oz. of silver.

Jewel Lake Area.†

Dentonia.—Situated near Jewel Lake. Owned by the Dentonia Mines, Limited, and operated under lease by John Halstrom, Eric Sojberg, and Robert Lee, of Greenwood, who employed one man. A total of 1,873 tons of ore mined and shipped to the Trail smelter yielded 614 oz. of gold and 4,307 oz. of silver.

North Star.—Located near Jewel Lake. Operated by the Greenbridge Gold Mines, Limited, with Chas. C. Walker in charge of operations. The mine was reopened in May and operated for the remainder of the year; nine men were employed, with three underground. A mill put on the property last year has not been set up for operation. Development-work included 57 feet of drifting, 151 feet of crosscutting, and 151 feet of raising. A total of 220 tons of ore mined and shipped to Trail yielded 22 oz. of gold and 192 oz. of silver.

Paulson Area.†

Molly Gibson.—Situated in Burnt Basin, about 4 miles from Paulson. Operated by the Molly Gibson Mines, Limited; head office, Calgary, Alta.; under the direction of George H. Tyrrell. A crew of four men, with two underground, was employed for the greater part of of the year. Development included 45 feet of drifting, 304 feet of crosscutting, and 83 feet of raising; 22 tons of ore was mined and shipped to Trail, the returns giving a metal content of 32 oz. of gold and 10 oz. of silver.

Berlin and Inland Empire.—Situated about 5 miles east of Paulson. Operated under lease by the Inland Empire Mining Syndicate; Rudolph Nelson, of Paulson, B.C., being in charge of operations. Ten men, seven of whom worked underground, were employed from October to the end of the year. The property has not been worked for about fourteen years and considerable repair-work is required to put the mine in good condition. The operators plan eventually to ship a large tonnage of low-grade siliceous ore to Trail. A total of 541 tons of ore, mined and shipped to the Trail smelter, yielded 121 oz. of gold and 1,142 oz. of silver.

GOLD-COPPER DEPOSITS.

*Similkameen River Area.**

Red Buck.—Fred Foster, manager. This mine is 13 miles west of Princeton, on the north side of the Similkameen River, and is accessible by a winding trail down the side of the mountain to the river from the Hope–Princeton Highway above. The portal of the main No. 1 adit is at the side of the river and the face is now 700 feet in from the portal; a small amount of crosscutting has been carried on from the main adit and raises have been put up to No. 2 adit some 200 feet above. Work done during the year was generally concentrated on the completion of an aerial tramway from the mine to an ore-bin across the river, and situated near the railway that gives access to the coarse crushing plant of the Granby Company's mine at Copper Mountain. It is a modern haul-back aerial tramway, approximately 1,000 feet in length, with a difference of 350 feet between the upper and lower terminals; the buckets have a capacity of 1.5 tons, and the system is operated by two 25-horse-power electric motors.

† By H. C. Hughes.
* By John G. Biggs.

During the present year a 100-ton flotation-mill was completed near the railway. It is operated by a 212-horse-power Petter 4-cylinder Diesel engine direct-coupled to a Westinghouse electric generator. This power is transmitted to the mill for the operation of the different power units, each unit is provided with a separate drive with the object of avoiding line shafts. The mill went into operation on December 8th.

The power for operating the mine and the aerial tramway consists of a McCormick-Deering Diesel unit coupled direct to a 50-k.v.a. electric generator, and a 112-horse-power Petter Diesel engine coupled to a new Holman 2-stage air-compressor having a capacity of 550 cubic feet of free air per minute for the operation of the drills.

There were twenty men employed on surface construction-work.

Grand Forks Area.†

Fife.—Situated near the outlet of Christina Lake. The property was operated under lease by Chas. C. Walker and associates, who employed two men. The winze from the low-level adit was dewatered and an examination made, but no further work done.

Phoenix-Eholt Area.†

Brooklyn.—Situated near Phoenix. Owned by Robert Forshaw and operated under lease by W. E. McArthur, of Greenwood. A total of twenty-one men, with nine underground, was employed in the mine and the *Providence* mill, now owned by the lessor. Development-work included 100 feet of drifting and 300 feet of raising. In addition, a 200-ton ore-bin was constructed and a new Gardner-Denver compressor driven by a 100-horse-power Diesel was installed. At present the mine is being dewatered to the 250 level with the expectation of an extension of the present ore, which was not found by the former operators. A total of 12,775 tons of ore was mined and treated in the *Providence* mill. The concentrates from this, shipped to the Tacoma smelter, yielded 2,611 oz. of gold, and 2,425 oz. of silver, and 167,395 lb. of copper.

Marshall Group.—Situated near Phoenix. Owned by Robert Forshaw, of Greenwood, and optioned to the Consolidated Mining and Smelting Company of Canada, Limited, who did surface-trenching involving the removal of 38,142 cubic feet of material, and 1,347 feet of diamond-drilling.

Athelstan.—Situated in the Wellington Camp, near Phoenix. Operated under lease by W. E. McArthur, of Greenwood, who employed four men, three underground, for several months of the year. Development-work included 100 feet of tunnelling and a large amount of surface stripping and trenching. Because of the high arsenic content, only selected portions of the ore were mined. A total of 353 tons ore was mined and shipped to the Tacoma smelter. This returned 172 oz. of gold and 284 oz. of silver. A new crosscut tunnel, estimated to be 250 feet long, is being driven to open up the ore at greater depth.

Granby.—Situated at Phoenix. Owned by the Granby Consolidated Mining, Smelting and Power Company, Limited, and operated under lease by W. E. McArthur, of Greenwood, B.C. Except for the removal of considerable overburden and old dumps, very little development-work was done on this property. When mining operations at the *Brooklyn* were suspended because of the dewatering of the lower workings, some 55 tons per day of low-grade gold-copper ore was mined from the old glory-hole and treated in the mill at Greenwood. The concentrates from 4,331 tons of ore mined, when treated at the Tacoma smelter, yielded 337 oz. of gold, 951 oz. of silver, and 72,129 lb. of copper.

B.C.—Situated about 2 miles east of Eholt. Owned and operated by the B.C. Eholt Mines, Limited; A. M. Dockstader, manager. Seven men were employed from May until September, with four working underground. Steam power was used to produce compressed air for underground work. This was confined to a small shaft about 500 feet from the old main workings. This shaft was put in repair and a gasoline-driven hoist installed. About 150 tons of ore was mined from this working but was not treated.

COPPER DEPOSITS.*

Granby Consolidated Mining, Smelting and Power Co., Ltd.—A. S. Baillie, president and managing director; W. R. Lindsay, resident manager; F. Buckle, general superintendent.

† By H. C. Hughes.

* By John G. Biggs.

The *Copper Mountain* mine and the concentrator at Allenby have been in continuous operation since operations were resumed early in 1937 following a suspension of several years. The mine is near the peak of Copper Mountain, at an elevation of 4,000 feet, and is 12 miles west of Princeton; the concentrator is at Allenby, 4 miles west of Princeton. A branch line of the Kettle Valley Railroad, from Princeton, connects all three points.

The main development of the mine is by two main adit haulage tunnels known as Nos. 2 and 6 levels, and a large part of the ore handled on No. 2 level is produced by surface glory-holes; all the ore is passed by haulage and transfer-chutes to No. 6 level on which is the main transportation system of the mine. The ore is crushed at the portal of No. 6 level and carried on the railroad to the concentrator at Allenby, 8 miles distant.

During the year two more levels—Nos. 7 and 8—have been driven 200 feet and 400 feet respectively below the main level. This new development is serviced by a well-equipped vertical shaft from the upper levels.

Development during the year consisted of 8,904 feet of drifting and crosscutting, 9,322 feet of raising, and 3,542 feet of diamond-drilling; 1,223,200 tons of ore was mined and milled, and this produced 29,652,613 lb. of copper, 8,730 oz. of gold, and 214,676 oz. of silver.

Mining generally is by the shrinkage system and a large percentage of the ore is blasted by the multiple-shot method, by which from 2,000 to 3,000 shots are blasted at one time; this type of blasting is carried out at a week-end when all persons are out of the mine except the few required to attend to the final blasting. Power for the operation of the mine and concentrator is produced at the company's plant at Princeton where a modern 2-unit boiler installation supplies steam requirements for three turbines driving three generators of 500 k.w., 2,000 k.w., and 5,000 k.w. respectively at a voltage of 13,800 volts, at which pressure the power is carried to the transformers at Allenby and Copper Mountain. One of the above boilers is fired by pulverized coal and the second by Harrington chain-grate stokers.

GOLD-SILVER-LEAD DEPOSITS.

Greenwood Area.†

Providence.—Situated about 1 mile north of Greenwood. Operated by the Riegel Mines, Limited; O. D. Thompson, manager. The mine was operated continuously from May until the end of the year with a crew of seven men, four of whom were employed underground. Development-work consisted of 875 feet of drifting. A total of 144 tons of ore mined and shipped to the Trail smelter yielded 89 oz. of gold, 20,425 oz. of silver, and 6,072 lb. of lead.

Combination.—Situated about 1½ miles north-east of Greenwood. Operated by W. J. Roger and Pulver, of Seattle, Wash., with R. C. McLanders in charge of operations. A power-house and blacksmith-shop were built and a small semi-portable gasoline-driven compressor was installed. Five men, with three underground, were employed for a short time. It was planned to drive a low-level crosscut to get depth on the vein but very little underground-work was actually done.

SILVER-LEAD DEPOSITS.

Beaverdell Area.†

Highland Bell.—Situated on Wallace Mountain. Operated by the Highland Bell, Limited, with N. M. Mattson as manager. This mine continued to be operated profitably during the year. A crew of thirty-eight men was employed, with twenty-seven working underground. The problem of locating the faulted segments of the ore—this condition being a feature of the Beaverdell area—continues to be successfully met. Late in the year the *Highland Bell* acquired a control in the adjoining *Beaver* claim. Development-work included 700 feet of drifting, 500 feet of crosscutting, 300 feet of raising, and 50 feet of sinking. In addition a geophysical survey of the property was completed during the summer months. A total of 5,100 tons of ore mined and shipped to the Trail smelter yielded 815,249 oz. of silver, 88 oz. of gold, 473,727 lb. of lead, and 614,911 lb. of zinc.

Sally.—This property, adjoining the *Highland Bell*, was operated by the Sally Mines, Limited, with N. M. Mattson in charge. Four men, three underground, were employed for the first part of the year. The work consisted chiefly of cleaning up the old stopes and mining the remains of ore-bodies left by former operators. Development included 200 feet of drift-

† By H. C. Hughes.

ing and 100 feet of crosscutting. A total of 213 tons of ore mined and shipped to Trail yielded 2 oz. of gold, 12,142 oz. of silver, 10,887 lb. of lead, and 22,268 lb. of zinc.

Wellington.—Situated on Wallace Mountain. Operated by the Beaverdell-Wellington Syndicate, Limited. A. J. Morrison, manager, and Geo. Boag, mine foreman. The mine worked continuously throughout the year, an average of twenty men being employed, with twelve underground. Development included 612 feet of drifting, 240 feet of raising, and 12 feet of sinking. A total of 1,647 tons of ore mined and shipped to the Trail smelter yielded 42 oz. of gold, 94,736 oz. of silver, 75,572 lb. of lead, and 109,932 lb. of zinc.

Bounty and Bounty Fraction.—This property adjoins the *Wellington* and is controlled by that company and operated under the same management. Operations were commenced in November and a crew of three men, with two underground, was employed from then on. A new compressor-house was built near the portal of the low-level adit and the *Bounty* Diesel and compressor installed in it. The present management feel that, with their knowledge and experience in local faulted conditions, they will be able to locate blocks of ore overlooked by former operators. Development-work included 120 feet of drifting.

Beaver.—Situated on Wallace Mountain, adjoining the *Highland Bell* and *Sally*. This property, formerly owned by the Beaver Silver Mines, Limited, is now controlled by the *Highland Bell*. It is being operated by Homer S. Nordman and associates under a lease which has two years to run. Four men, with three underground, were engaged on this lease throughout the year. The area being worked under this lease is a considerable distance from the *Highland Bell* line and their operation should in no way interfere with the leasers. Development-work included 320 feet of drifting and crosscutting and 120 feet of raising. Ore totalling 178 tons mined and shipped to Trail yielded 6 oz. of gold, 30,880 oz. of silver, 22,068 lb. of lead, and 38,874 lb. of zinc.

Tiger.—Situated on Wallace Mountain. Owned by the Wm. Law estate and operated under lease by John L. Nordman and partner. Compressed-air, piped from the *Beaver*, was used underground. A total of 53 tons of ore mined and shipped to Trail yielded 1 oz. of gold, 10,131 oz. of silver, 11,741 lb. of lead, and 11,671 lb. of zinc.

Rambler.—Situated on Wallace Mountain. Owned by W. H. Rambo and A. S. Black and operated under lease by the R.S.K. Mining Syndicate, of Beaverdell, with John McDonnell in charge. Three men, all working underground, were engaged in this lease. Development-work included 90 feet of drifting, 40 feet of crosscutting, 15 feet of raising, and 30 feet of sinking. A total of 3 tons of ore was mined and shipped to Trail, yielding 280 oz. of silver, 270 lb. of lead, and 449 lb. of zinc.

Highland Chief.—Situated on Wallace Mountain adjoining the *Highland Bell* mine. Owned by Mark Smith, of Beaverdell, and operated under lease by a local syndicate with Alex. Bell in charge. Three men were employed underground, all work being done by hand-steel. Development included 221 feet of drifting, 91 feet of crosscutting, and 19 feet of raising. All ore mined had to be hauled to the *Highland Bell* road over a raw-hide trail a distance of about half a mile. A total of 3 tons of ore mined and shipped to Trail yielded 281 oz. of silver.

British Silver and Gold Mine Proposition.—This syndicate, composed of Gilbert Prideaux, Perley Russel, and G. G. Lyall, of Princeton, and Manley and Miller, of Grand Forks, controls a group of seven claims on Wallace Mountain adjoining the *Wellington* mine. The syndicate was formed and work done with the idea of prospecting for the possible extension of the *Wellington* vein, along the strike, particularly on the *British* claim. The management believe that although no commercial ore has been found to date, an area of similar geological conditions to those where ore has been mined in the *Wellington*, has been uncovered. Development-work done this season included 400 feet of surface trenching and 77 feet of tunnelling.

PLACER-GOLD DEPOSITS.

Greenwood Area.†

May Creek Placers.—Situated on May Creek, about 16 miles east of Grand Forks. Operated by H. L. Armand, manager, and H. F. and D. E. Butchart and J. G. Johnson, all of Chilliwack, B.C. Water from May Creek was conducted through 1,000 feet of pipe to

† By H. C. Hughes.

operate a monitor. The creek-banks and near-by benches were washed through sluices by this means. The operation was handicapped by lack of water. A 32-volt Delco plant provided light for a two-shift operation. Production was small.

Boundary Gold Placers.—Situated on Boundary Creek, about 5 miles west of Greenwood. Operated by the Boundary Gold Placers, Incorporated; Fred Simpson, of Greenwood, manager. A dam and flume were constructed, the latter being calculated to carry the creek over the ground to be worked. This proved inadequate during the high water, so much so that a great deal of extra work was necessary to save the plant. To lift the gravel from the bottom of the pit at bed-rock a 14-inch Hendy hydraulic elevator was used. Water to operate this was taken from the main supply pipe-line, the headgate of which was located about 2 miles up the creek, and the pressure augmented by a 12-inch discharge Kimball-Krogh centrifugal pump driven by two 100-horse-power Cummings Diesel engines. Gravel in the pit was handled by a No. 4 monitor operating under 186 feet of head. The elevator, capable of handling boulders up to 10 inches in diameter, discharges directly into a 4-foot sluice box which dumped the tailings some little distance down the creek. This arrangement depended on the high water eventually to carry them away. The operation was evidently not successful, for the plant was dismantled late in the summer. Ten men were employed during the summer.

NON-METALLIC DEPOSITS.

Vicinity of Grand Forks.†

Fife Limestone Quarry.—This property is owned by the Consolidated Mining and Smelting Company of Canada, Limited. Twelve men, working on contract, shipped 19,943 tons of limestone from this property to the Trail smelter.

† By H. C. Hughes.