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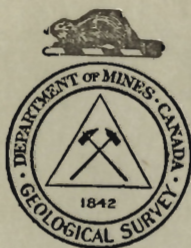
CANADA
DEPARTMENT OF MINES
HON. W. A. GORDON, MINISTER; CHARLES CAMSELL, DEPUTY MINISTER

BUREAU OF ECONOMIC GEOLOGY
GEOLOGICAL SURVEY

MEMOIR 179

**Lode Gold Deposits of Fairview Camp,
Camp McKinney, and Vidette Lake
Area, and the Dividend-Lakeview
Property near Osoyoos, B.C.**

BY
W. E. Cockfield



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

Price, 25 cents

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Lode Gold Deposits of Fairview Camp, Camp McKinney, and Vidette Lake area, and the Dividend-Lakeview property near Osoyoos, B.C.

FAIRVIEW CAMP

A short time was spent during the field season of 1934 visiting the operating properties of Fairview Camp in southern Okanagan valley. Attention was paid chiefly to the Morning Star and Fairview Amalgamated properties, but brief visits were also made to several others. The writer was ably assisted in the field by J. M. Black.

These properties are a short distance northwest of Oliver. A highway connecting with Similkameen valley, and joining the transprovincial highway at Oliver, passes through the camp. A branch of the Kettle Valley railway extends from Penticton to a short distance south of Oliver. The camp is thus readily accessible. A power line of the West Kootenay Power Company also passes through the camp.

The areal geology of the quadrangle in which Fairview Camp is situated has been mapped by H. S. Bostock of the Geological Survey, and the unpublished manuscript of this map was made available to the writer, who acknowledges his indebtedness to this work. Early in 1934, Mr. C. C. Starr made a detailed map and report on part of the Morning Star property. The main geological boundaries of this map were used by the writer in compiling the sketch map accompanying this report, and this materially shortened the work necessary to outline the geological features of the properties. A report on the mineralogy of the ores, by Mr. H. V. Warren, was also used by the writer. Acknowledgment is also due to the management of the various properties visited for the facilities placed at the disposal of the writer, for which the writer expresses his thanks.

Fairview Camp is one of the older mining camps of the province that have been revived recently owing to the rise in the price of gold. Many of the claims of the camp were staked in the early nineties and the greater part of the work done on them was prior to 1900. Some, such as the Stemwinder, Morning Star, and Rattler, are credited with the production of ore, the main producer was the Stemwinder. For the early history of the camp, and figures as to production, the reader is referred to the reports of the British Columbia Minister of Mines.

The properties are situated on a rather gently sloping, northeasterly facing hillside, but the topography is minutely rough, as the slope is intersected by a number of draws, which in general trend northwest.

GENERAL GEOLOGY

The rocks in the immediate vicinity of the ore-bodies compose three main groups, in addition to associated dyke rocks. The oldest group is a series of schists, largely of sedimentary origin, and consists of micaceous or graphitic quartzites, mica schists, and minor amounts of crystalline limestone. All these rocks have a pronounced schistosity striking north-westerly and dipping at varying, generally steep, angles to the northeast. The schists are generally dark, and those specimens examined under the microscope, consisting chiefly of the quartzitic members of the series, show granulated quartz, with mica or graphite arranged in bands that mark the planes of schistosity. This group is shown on Bostock's map as being the Anarchist series.

The second group, referred to on the accompanying map as the Fairview granite, are medium-grained, flesh-coloured to light brown rocks with a granitic texture, and occur in a belt to the southwest of that part of the mineral zone under discussion. In places they have a slightly defined gneissic structure. Under the microscope the specimens selected for examination showed quartz, andesine, a little orthoclase, biotite or muscovite, and pyroxene. In some specimens the quartz shows pronounced granulation; these are specimens that microscopically show gneissic structure. From the specimens examined the rock may be classed as a quartz diorite.

The third group, shown on the accompanying map as the Oliver granite, consists of light pink to grey, medium to coarse grained rocks of granitic texture. These occupy a wide belt to the north of that part of Fairview Camp examined. Under the microscope the specimens examined showed quartz with abundant orthoclase and microcline, a little oligoclase, with biotite or muscovite, and, in one case, pyroxene. The rocks may be classed as granites. In some cases the Oliver granite is accompanied by what appears to be a basic border phase, which is a fine-textured, dark green rock. Under the microscope this rock is seen to be composed of decomposed feldspar, hornblende, and chlorite, with a little pyroxene. The rock is holocrystalline, but the feldspars occur largely in the form of thin laths. From the occurrence at the points noted it could not be told whether this is a basic segregation at the margin of the intrusive, or a separate intrusion. It was judged, however, to be the former, as it appears at many points along the contact.

Dyke rocks of two general types were recognized. The rocks of one group, which may be considered together, although possessing differences from point to point, occur as dykes and sills, which appear to be most numerous near the contact of the Fairview granite. At many points members of this group were observed in close connexion with the veins. They are generally light grey to white, fine-grained rocks with a felsitic groundmass and with phenocrysts of quartz, or quartz and feldspar. In general the phenocrysts are not very abundant; a few rocks of this group are fine in grain. Under the microscope phenocrysts of quartz appear in some specimens, and of feldspar in others, and a few have phenocrysts of both quartz and feldspar. The feldspars are generally well zoned. The groundmass is usually very fine in grain and consists of feldspar and quartz with shreds

of biotite or muscovite. The fine-grained varieties show abundant white mica, abundant plagioclase, and very little quartz. The rocks vary from quartz porphyry to dacite porphyry. Veins of calcite commonly traverse the specimens. These rocks are fairly common in the underground workings; one dyke or sill is found in places along the Morning Star vein, and examples are also to be found in the crosscuts from the second level; sills of similar rock are to be found in the workings of the Silver Crown claim, and one wide sill was noted close to the south vein of Fairview Amalgamated. On the surface numerous sills and dykes occur, cutting both the Anarchist schists and the Fairview granite. They were not observed cutting the Oliver granite, but sufficient work was not done on the Oliver granite to permit a categorical statement that these rocks do not cut it.

A second group of dyke rocks was noted on the Morning Star property. These are fine-grained, dark greenish rocks in which the individual crystals are not discernible on examination in the field. Under the microscope they are seen to consist essentially of feldspar, with chlorite and hornblende. The feldspar is highly altered. They possess somewhat striking resemblances to the rocks already referred to as the basic border phase of the Oliver granite. They were observed cutting the Fairview granite and also the rocks of the Anarchist series, but were not actually observed to cut the Oliver granite.

The age relations of the Fairview granite and the Oliver granite were not observed. On his regional map, however, Bostock shows the Fairview granite as a distinct intrusion, older than the Oliver granite. The slight evidence obtained in the field would tend to support this view. The two are somewhat dissimilar in composition, and the Fairview granite is in places gneissic, whereas the Oliver granite is massive, and dyke rocks observed cutting the Fairview granite were not observed to cut the Oliver granite. It is believed that the acidic type of dyke rocks previously described are apophyses of the Fairview granite rather than of the Oliver granite. Their close association with the former tends to support this view, but it must be admitted that the evidence on this point is rather slight.

ORE DEPOSITS

The ore deposits of Fairview camp consist of quartz mineralized with small amounts of pyrite, galena, and zinc blende. All are probably connected in genesis and belong to the same period of mineralization, but for purposes of description they may be classed as occurring in three ways, namely, veins in the schist, conforming closely to the strike and dip of the schistosity; veins in the schist, crosscutting the schist in dip and strike; and veins in the granitic bodies. The first type has probably received the greatest amount of development and consists of those chiefly studied during this investigation. They apparently formed along fault fissures conforming closely to the schistosity, which in turn corresponds closely to the bedding. In instances, however, the veins appear to cross the bedding at low angles, for beds of different character appear along the strike of the veins. As the schistosity follows closely the contact of the Fairview granite, these veins may be said to be roughly parallel to that contact. The

degree of silicification taking place along the veins varies greatly from place to place; at some points wide bulges of quartz appear, and at others the silicification dies out altogether along the strike to reappear along approximately the same zone after an interval in which no quartz is visible. It is consequently not possible to relate veins from property to property with assurance. On the ground being worked by Morning Star (Fairview) Gold Mines, Limited, there are two main veins roughly parallel to one another; on the adjoining Silver Crown there are a number of veins that cannot be related to the Morning Star veins; on the Stemminder property two veins outcrop, and a third has been reported from the underground workings; and on the Fairview Amalgamated there are traces of three main veins which are probably the same as occur on the Stemminder property.

The veins as shown on the surface and in the underground workings vary greatly in width from great masses of quartz up to 30 feet wide, to narrow veinlets of partly silicified schist. A number of veins, parallel in a general way to the main system, are known to occur, but most of these have not as yet been traced for any considerable distance.

The second group, namely veins crosscutting the schist in dip and strike, is relatively unimportant. For the most part the veins are small, and can be traced for only short distances. They generally dip at steep angles, and although not observed to do so it is believed that they unite with the veins of the first type to form a vein system. One example of a fairly continuous vein of this type may be observed on the Wide West claim of the Federal Mining and Smelting Company, and may be traced, by means of open-cuts, for several hundred feet.

The veins occurring in granitic rocks have apparently no general direction of dip or strike. Examples were noted of veins ranging from almost flat to nearly vertical within a short distance of each other. Several veins were noted in the granitic rocks which appeared to be fairly persistent along their strike.

Post-mineral faulting was noted in a number of cases. One large fault was worked out by Starr on the lower part of the Morning Star property, and a number of minor faults occur on the same property, and may be observed both on the surface and in the underground workings. A large fault probably crosses the Stemminder claim in a draw to the west of the main shaft, and a number of minor faults occur in the workings of the Fairview Amalgamated. The Susie vein, occurring in the Oliver granite, is reported to be cut at one end by a fault. In most of the cases of faulting observed the displacement is small, and the faults are generally of the normal type.

The ore occurs in the form of shoots. Considerable stretches of the veins are of comparatively low value, that is to say, below commercial grade. The gold appears to be very largely associated with the galena and zinc blende, and not with the pyrite. The leaner parts of the veins, particularly in the underground workings, usually carry considerable pyrite. It cannot, however, be asserted that the galena and zinc blende are in every case indicative of high gold values, as in some cases where the veins are well mineralized with these sulphides the values are low.

The actual cause determining the locus of ore shoots is not known. In certain instances the ore shoots are located at the wider parts of the veins, but good values may also be found at narrow parts. A very large part of the veins exposed at the surface appear to be comparatively barren, and also to contain very little sulphide, and instances are known, as on the Fairview Amalgamated, of the occurrence of ore shoots fairly deep below surface outcrops that are practically barren. Most of the ore so far developed lies fairly close to the surface, but it should be remembered that no deep development has taken place in the camp. In some cases ore has been found at the surface, as for example on the Morning Star and Susie properties. It is not known whether the ore shoot on the Fairview Amalgamated extends to the surface, whether it is one of a series extending to the surface, or whether it occurs only on the horizon where encountered, as raising through it had not been started. It might, however, be accepted as suggesting that ore shoots may occur at any horizon within the veins, and that consequently a barren level beneath existing ore shoots does not necessarily prove that the bottom of the productive zone has been reached. On the whole the amount of development work that is accessible gives insufficient data to permit of generalizations on the behaviour of the deposits in depth. The individual ore shoots seen are comparatively short, being of the order of about 200 feet. There is no evidence of secondary enrichment of the deposits; the ores are judged to be primary.

It is probable that fissuring developed as a result of stresses during the injection of the granitic masses, or as a result of the cooling of those masses. The quartz probably grew along the fissures in part by replacement of the wall-rock. In the veins at places are unreplaced or partly replaced fragments of rock—in the case of the schist these are in general bands of mica which suggest unreplaced parts of the wall-rock. It cannot be said that the amount of replacement corresponds to the character of the rock being traversed. In instances it would appear that the quartzites and dyke rocks were the most favourable to replacement, and the highly micaceous rocks the least favourable. In the latter the vein zone is apt to consist of a number of stringers of quartz with mica schist between; but on the other hand wide bodies of quartz may be observed in the mica schist, and in other cases the silification may be observed to die out rather rapidly along the strike without a corresponding change in the character of the wall-rock.

As the veins occur in the Oliver granite and as in one case it is now reported that a vein has been traced from this rock into the schist, making it appear that the veins of the different types cited have a common age and origin, it would appear that they formed after the consolidation of the Oliver granite and are probably connected with the end phase of that intrusion.

The results of examinations of the ores made by Warren and contained in the unpublished report previously referred to, show an earlier generation of milky quartz, containing little sulphide, followed by pyrite, then a dark quartz, galena, and zinc blende. Warren states that the pyrite is fractured and the cracks healed by the dark quartz. In the specimens examined by the writer corroborative evidence of two genera-

tions of quartz could be seen. It is uncertain whether these two periods of mineralization followed closely upon one another, or were separated by a considerable interval. Veinlets of calcite traversing the quartz probably represent the last stage in the development of the veins.

DESCRIPTION OF PROPERTIES

Morning Star (Fairview) Gold Mines, Limited, own a group of claims extending along the schist belt from the Rattler to the Silver Crown. The chief development has been on the Morning Star claim.

This property was operated some thirty-six years ago by S. Mangott and associates, and it is reported that several hundred tons of rich ore were mined from the outcrop of the vein. A considerable amount of development work was subsequently done, but the ore found in this work was not mined, and the property lay idle for many years, until the spring of 1933 when the present company was formed and took over the property.

Two strong vein zones outcrop on the property. They are both of the type referred to as being parallel to the strike and dip of the schist. The larger of the two, known as the west vein, outcrops just west of the main shaft, is exposed for about 200 feet along the strike, and has a maximum width of about 30 feet. It is from this outcrop that the ore extracted in the early days, previously referred to, is reported to have been taken.

The other vein, known as the east vein, outcrops about 200 feet to the east and can be traced at intervals for the greater part of the length of the Morning Star claim, and into the Ontario claim. It varies considerably in width, the maximum being about 14 feet. Other veins occurring on the Evening Star to the southeast and on the Silver Crown to the northwest cannot with certainty be referred to either of these two veins.

The main workings are on the west vein, but a considerable amount of work has also been done on the east vein. The west vein dips at an angle of 40 to 50 degrees and the main shaft of the property is an incline that cuts into the west vein at a depth of 60 feet and then follows it a distance of 150 feet along the dip to the second level. Two levels have been driven from this shaft, both in a northerly and in a southerly direction. On the first level the south drift at the time of the writer's visit was about 400 feet long, and the north drift some 660 feet long. To the south an ore shoot was encountered about 60 feet from the shaft, and is roughly 180 feet long. North of the shaft an ore shoot roughly 200 feet long was encountered near the shaft and a raise put through to the surface. Beyond this ore has been encountered at a number of points, but not in continuous bodies. Other ore shoots have since been reported but were not opened up at the time of the writer's visit.

From about opposite the raise on the north ore-body a crosscut has been driven to the east vein a distance of 205 feet, and short drifts have been run north 60 feet and south 110 feet on the vein. From the south drift near the crosscut a raise has been put through to the surface. At 160 feet in the crosscut between the two veins a quartz stringer was encountered, which was drifted on for about 10 feet in either direction.

On the second level the drift south from the shaft on the west vein continues for 185 feet with a crosscut of 15 feet at the end. A short stretch of ore was encountered in this drift. The north drift was driven for 540 feet with short crosscuts both east and west at the end.

A winze connects the No. 1 and No. 2 levels on the west vein in the vicinity of the north ore-body, and values are reported at points in this winze.

The west vein throughout the workings shows a fairly continuous zone of silicification. The quartz in places widens to form large masses and in others narrows to a number of veins or stringers in the schist. The vein appears to conform to the schist in dip and strike, but probably crosses the strata at very low angles, for beds of different character appear as the wall-rock, quartzite, porphyry, and mica schist being found at different places in the workings. Dykes and sills of quartz porphyry and dacite porphyry may be seen throughout the workings. One appears as the wall of the vein at intervals on both the first and second levels, and others are exposed in the crosscuts on the second level.

The ore minerals are pyrite, with galena and zinc blende. The gold values appear to follow the latter two minerals, but this is not a universal rule, as places may be found where these two minerals are abundant, but only low gold values occur. It is stated that where the galena and zinc blende are very finely crystalline the gold values are almost invariably high.

The east vein where exposed in the underground workings in the north drift consists of several stringers of quartz making up a zone 1 to 2 feet wide, whereas in the south drift it consists of a single stringer. In the raise on this vein to the surface a strong body of quartz was encountered a short distance below the surface.

On the Silver Crown claim there are a number of veins, some of which appear to start near the contact of the Fairview granite with the schists and appear to die out rapidly away from that contact. One strong vein appears outside the portal of the adit that has been driven on this claim, and may be observed in pits to the southeast; but it was not observed to the northwest of the adit.

The adit is a crosscut about 150 feet long and the main vein of the workings is encountered about 85 feet from the portal. This varies considerably in width, being in places about a foot wide, increasing to a maximum of about 9 feet, and has been drifted on a short distance to the north and to the south from the crosscut. A short raise has been put up on the vein from the south drift near the crosscut and from this point a winze, now full of water, has been sunk. The vein is mineralized with pyrite, galena, and zinc blende, but the values are stated to be low, except in the north drift and in the raise. Several sills of quartz porphyry appear in the workings.

Veins of the same type appear on the Evening Star and Rattler claims, but were not examined in detail.

On the Black Diamond claim a vein transverse to the strike and dip of the schists is exposed in an old shaft partly filled with water. This vein has a strike of north 30 degrees east, dips practically vertically, and has

a maximum width of about 2 feet. It can be traced for only a short distance. At the shaft it is well mineralized with pyrite and galena and is reported to carry fair gold values.

To the south of the Black Diamond fraction a rather persistent vein 3 to 4 feet wide occurs in the Fairview granite, but those parts of the outcrop observed appear to carry very little sulphide.

A number of other veins occur on the property, which were not examined in detail, but which appear to be similar in their general characteristics to those described.

The Morning Star property has made regular shipments of ore since July. In the published report of the company shipments for the year are given at 2,983 tons with a gross value in gold of \$55,936.

Stemwinder. This property adjoins the Morning Star property on the northwest and is the most extensively developed of the Fairview mines, but as the workings were full of water at the time of the writer's visit no description can be given. The reader is referred to the reports of the British Columbia Minister of Mines.

Three veins are reported from the workings of this property, known as the North, Main, and South veins, which are probably continuous with those of the Fairview Amalgamated veins to the northwest. The property was developed to a depth of 500 feet and a considerable amount of ore produced, but the mine has lain idle for nearly thirty years. During the summer it is reported that the workings were pumped out for examination by the Morning Star (Fairview) Gold Mines, Limited, but the results of this examination are not available.

Fairview Amalgamated Gold Mines, Limited. The claims of this company adjoin part of the Morning Star and Stemwinder properties. The main workings are situated on the slope of a fairly steep hill and are some 2,000 feet westerly and nearly 400 feet in elevation above the Stemwinder shaft. A number of shafts and shallow pits, and outcrops of veins at intervals from the flat above this steep hill down the slope to the Stemwinder property, indicate there are three main veins, partly on this and partly on the upper part of the Stemwinder property. A short adit driven in the face of the hill about 250 feet in elevation above the main workings was not examined.

The main workings consist of an adit that follows the south vein for approximately 750 feet, at which point a short crosscut leaves this vein and enters the main vein. The drift along the south vein continues, however, for another 50 feet, where another short crosscut runs to the main vein. From the first of these crosscuts drifting had been carried along the main vein in an easterly direction, with crosscuts at intervals to expose the full width of the vein. At the time of the writer's visit this work had been carried along the main vein for about 100 feet. According to information supplied by Mr. B. W. W. MacDougall, consulting engineer for the property, this drift, at the time of writing, had been carried in for a distance of 350 feet.

From the point where the second crosscut enters the main vein, the vein had been opened up along a westerly direction for about 150 feet

at the time of the writer's visit, but this drift is now reported to be 450 feet along the vein, with crosscuts at intervals to expose the width of the vein.

The south vein in the drift forming the adit is from 2 to 5 feet wide. Near the portal this vein has a strike of north 10 degrees east and a dip of 20 degrees to the southeast, but it swings progressively in the drift until its strike is north 50 degrees west and the dip steepens to 35 degrees, thus assuming an attitude approximately parallel to the main vein. At 370 feet in the adit, a long crosscut has been driven into the foot-wall of the vein. This encounters a few feet stratigraphically below the vein a thick sill of dacite porphyry.

In that part of the eastern drift on the main vein, seen by the writer, the vein varies considerably in width, but may be considered as a vein zone 15 to 25 feet wide. In this section there is a hanging-wall vein and a foot-wall vein, the latter consisting of massive quartz with a considerable amount of pyrite. The hanging-wall vein consists of one or more veins or lenses of quartz in well-sheared rock. Pyrite is abundant in the quartz and in the enclosing schists. Values have been obtained at many points along this section, and in some cases very high values in gold are reported, but these were judged from the information available at the time, which was admittedly incomplete, to be more or less sporadic, and not continuous enough to be classed as ore shoots. The work done in this section since the writer's visit is reported to show the hanging-wall vein tapering to a stringer with the foot-wall vein, which can be seen in the crosscuts, persisting to within a short distance of the face.

In the westerly drift, crosscutting of the vein had not been done systematically. It is reported that work here has been successful in indicating an ore shoot somewhat over 200 feet long, with a maximum width of 25 feet. In this section the vein is cut by a series of faults, and it is reported that the ore shoot is terminated at its western end by a flat-dipping fault. The faults seen by the writer in this section all appeared to be of the normal type and with small throw. The ore indicated on this level occurs at a depth of some 800 feet below the outcrop measured along the dip of the vein. Raising from the level to the surface to establish the continuity of the ore above has not yet been carried out.

It appears probable that near this ore shoot the south and main veins unite, or that a branch from the south vein enters the main vein, but sufficient work has not yet been done to prove this point.

No work is being carried out on the north vein of the property, which is situated some 400 feet distant from the main vein. This can be traced from the Wynn claim of the Stenwinder property at intervals to the top of the steep slope. Outcrops of veins occur on the flat at the top of the steep slope, but insufficient data are available to relate them with certainty to individual veins of the group now being worked. Only a small part of the holdings of the company were examined. On the remainder considerable prospecting work remains to be done to relate the various exposures.

Susie. Only a very brief visit was paid to the Susie group of the Federal Mining and Smelting Company, which was not then being operated. As the underground workings were full of water, little could be seen beyond

the surface exposures. The deposit apparently consists of a wide, flat-lying vein, striking near the shaft approximately north 10 degrees east and dipping about 25 degrees southeast. The vein where exposed had an apparent width of 10 to 15 feet, and fills a fissure in the Oliver granite. The width measured held some inclusions of the granitic country rock. The quartz observed on the dump was white with very little sulphide visible. It is reported that a considerable tonnage has been developed by the underground workings, and that a larger tonnage is indicated by diamond drill holes. It is also reported that the property has recently been re-opened and that a long crosscut adit will be driven below the present workings.

On a neighbouring claim, believed to be the Victoria, a fissure in the granite, striking north 50 degrees east and with a vertical dip, was observed. The fissure zone is about 8 feet wide at the top of a small, vertical cliff and about 4 feet wide at the bottom. It contains numerous stringers of quartz, but no statement as to values can be given.

Torres Group. This group is situated on Blind creek on the Similkameen slope, about a mile from the summit on the road between Okanagan and Similkameen valleys. It is being prospected by Viking Gold Mines, Limited. At the time of the writer's visit only preliminary prospecting had been done, but plant and equipment were being installed for more extensive development.

The showings consist of quartz veins of fair width in the Oliver granite. The lowest showing is on a quartz vein striking approximately east and west and dipping north at 40 degrees. A short adit has been driven on this vein, which is from 6 to 8 feet wide at the portal, narrowing down to 2 feet at the face. The vein consists of glassy quartz with many vugs. In the quartz in places along the adit very little sulphide mineralization was seen, but it is reported that galena, pyrite, and zinc blende were encountered in driving the adit. Above the adit the vein has been traced for 175 feet up the moderately steep hillside by means of open-cuts. At about 75 feet the vein is slightly faulted, but appears again in the open-cuts beyond, where its dip is about 60 degrees. At the end of the line of open-cuts the vein is again faulted. In this section of the vein, considerable pyrite appears in the quartz. There are no open-cuts above this point, but outcrops are reported on the top of the hill. These were not seen.

About 20 feet northerly from this vein near the end of the open-cuts another line of cuts exposes a second vein 6 to 8 inches wide, with apparently very little sulphide mineralization. This vein strikes south 10 to 15 degrees east and dips 50 degrees northeast; it is, therefore, converging towards the other at a low angle. Passing along this line of open-cuts, that is away from the first vein, the strike changes to south 60 degrees east and the vein widens to 3 feet. It is not known whether this change in strike is due to faulting or is an actual change in the direction of the vein. High assays have been reported at points from these veins, but in the absence of definite information no statement as to average values can be made.

CAMP MCKINNEY

During the field season of 1934 several weeks were devoted to a reconnaissance survey of Camp McKinney in Greenwood mining division. This work was of a preliminary nature only with the object of obtaining some information on the geological relationships of the ore deposits in that vicinity. The writer was ably assisted in the field by J. M. Black.

Camp McKinney was one of the early lode gold camps of British Columbia, with one property, the Cariboo, producing somewhat over \$1,000,000 in gold, largely between 1894 and 1903. A number of other properties were developed at this time, but so far as the writer is aware none of these produced important amounts of ore. In the spring of 1934 it appeared probable that Camp McKinney would be revived, but this hope was not realized. Options on various groups of claims were obtained by several companies and a certain amount of preliminary examination work was undertaken in the camp early in the summer, but very little actual prospecting was done until late in the season when some diamond drilling was done on the Cariboo property.

Camp McKinney is situated about 9 miles north of the International Boundary and nearly 6 miles north of Bridesville, a small village on the provincial highway between Osoyoos and Greenwood. A branch road leaves the main highway several miles east of Bridesville, and after passing through Camp McKinney rejoins the highway in the vicinity of Oliver. A branch line railway operated by the Great Northern railway passes through Bridesville; Rock Creek on the Kettle Valley railway lies 8 to 10 miles to the east of Bridesville. A power line of the West Kootenay Power Company passes through the heart of the camp.

TOPOGRAPHY

The area consists of a series of ridges which extend in a general southeasterly direction from Baldy mountain, the highest point in the district, with an elevation of 7,558 feet above sea-level. These ridges are separated from one another by the various branches of Rock creek. The lowest elevation reached by Rock creek in the area under discussion is about 2,600 feet, so that the maximum relief is in excess of 4,950 feet. The average relief is, however, much lower as very little of the area stands at elevations below 3,000 feet and a very considerable percentage of it lies above 3,500 feet. The ridges are generally well rounded, with long, somewhat gentle slopes, but in the vicinity of the main creeks the slopes become steep. The main creeks occupy deep, narrow valleys and nearly all have one or more stretches of rock canyon joining stretches where the creeks flow over glacial deposits.

A very destructive forest fire has swept through most of the area examined. This killed or burned off much of the timber and also destroyed mine buildings, headframes, and in some instances burned out the upper timbering of mine shafts, allowing these to cave and become so choked with debris that little could be seen of the vein outcrops.

GENERAL GEOLOGY

The rocks of the area have been divided into a number of groups, as shown by the accompanying map (316A). Owing to the limited area covered, and also in part because of the lack of outcrops, this division must be regarded as somewhat arbitrary and not fully based on age relations. Certain groups, it is believed, may be merged with others as the geological succession of the region is more fully worked out.

A group that represents probably the oldest rocks of the area has been assigned by Daly¹ to the Anarchist series, which consists very largely of highly metamorphosed sedimentary rocks but includes also altered greenstones and possibly also altered intrusive rocks. The sedimentary members of the group are the altered equivalents of quartzite, slate, and limestone, now micaceous quartzites, mica schists, and crystalline limestone. The quartzite is a grey to green rock, commonly sheared, and holding considerable mica and in some cases graphite. Under the microscope it presents the usual appearance of granulated and recrystallized interlocking grains of quartz, with small amounts of mica and chlorite. The mica schist is prevailingly dark in colour and consists essentially of the same minerals as the quartzites, but the mica and chlorite are much more abundant. Graphite is quite commonly developed also. Certain types of these rocks show extremely well developed foliation and should be classed as biotite gneisses rather than as schists. The limestones are blue-grey to white rocks, which occur probably as fragments of the original beds for they can never be traced for any great distance. The sheared greenstones are abundant in the area, but little can be said with regard to their relations with the remainder of the schistose rocks. It is possible that they represent both intrusive and extrusive types. Those examined under the microscope show fairly complete alteration to secondary minerals, so that it is almost impossible to ascertain the original character of the rocks. The age of these rocks grouped as the Anarchist series is uncertain. On his map Daly classes them provisionally as upper Palæozoic.

A second group of rocks which have only a limited development in the area are light grey, granitic rocks, quite generally gneissic, the outcrops of which have in some cases a slightly rusty appearance. It is believed that these are members of the Osoyoos batholith which occupies a large area to the west of the map-area under discussion. Those specimens examined under the microscope show abundant quartz, which is granulated and recrystallized in interlocking grains; microcline occurs in considerable quantity in all specimens and orthoclase in some. These feldspars make up a large proportion of the rock, and are generally much altered to secondary products. Plagioclase feldspar of the composition albite-oligoclase is generally present, but in minor amounts. The ferromagnesian mineral is generally muscovite and in one case small amounts of pyroxene; one of the specimens carried a few small grains of garnet. To the west the rocks of the Osoyoos batholith are somewhat more basic in character than the specimens above described, having the composition of granodiorite. These granitic rocks are intrusive into the schists of the Anarchist series, but their age relations with the other rocks of the area were not observed.

¹ Daly, R. A.: *Geology of the North American Cordillera at the Forty-ninth Parallel*; Geol. Surv., Canada, Memoir 38 (1912).

They are cut by dykes which also cut most of the other rocks of the area. On his map covering a strip to the north of the International Boundary Daly shows the Osoyoos batholith as probably Jurassic.

Another group of rocks that have only a limited development in the area consists of sheared basic intrusives. These rocks are found on the ridge to the east of Baldy mountain and also near the mouth of Jolly creek. The members on the ridge to the east of Baldy mountain are fine-grained, greenish rocks with a well-developed cleavage. Under the microscope it can be seen that they originally consisted of large individuals of hornblende, now partly altered to chlorite, with the balance of the rock made up of secondary quartz with small aggregates of zoisite. The individuals of hornblende are broken and bent and shreds of chlorite appear throughout the rock. The second exposure occurs on Jolly creek near its mouth and consists of serpentine highly sheared, with considerable pyrite developed in one place along a shear zone. These rocks should probably be grouped with the members of the Anarchist series, but as their relations to the members of this group were obscure it was considered advisable to map them as a separate unit. The members on the ridge to the east of Baldy mountain bear resemblances to some of the greenstones of the Anarchist series, but a wide belt with no outcrops separates them from the nearest outcrops of the Anarchist series. In the field no rocks similar to the serpentine mass on Jolly creek were seen elsewhere, but a later examination of parts of the drill cores obtained from the Cariboo property showed somewhat similar rocks, which are possibly contained within the Anarchist schists.

One of the main intrusive masses of the area extends in a belt varying in width from slightly over a mile to slightly over 2 miles, from the shoulder of Baldy mountain in a southeasterly direction to the main highway at Rock creek. Outcrops along this belt are by no means continuous, but it is believed that sufficient were seen to justify the conclusion that it is a continuous belt of granitic rocks. These are grey, medium to coarse-grained rocks with a granitic texture and in places are fairly deeply weathered, but in most cases are quite fresh. The specimens examined under the microscope show some quartz, abundant plagioclase (andesine), and some microcline or orthoclase, the latter two minerals being much less abundant than the plagioclase. The ferromagnesian minerals are in some cases biotite and hornblende and in other cases biotite alone. Some specimens show micrographic intergrowths of quartz and feldspar. The common accessory minerals are also present. The rocks fall into the general class of granodiorite to quartz diorite. These rocks intrude the schists of the Anarchist series, and are cut by a series of dykes which were not observed cutting members of a group of volcanics shown on the accompanying map, and are in consequence believed to be older than the volcanics. Their age relationships with the rocks of the Osoyoos batholith and with certain other granitic rocks that occur in the area could not be observed, for they were not found in contact with them. The contacts of this mass with surrounding rocks are rarely exposed. In certain instances, however, dykes nearly identical in composition with the main mass and believed to be apophyses from it were observed cutting the rocks of the Anarchist series a short distance from the contact. A small intrusive body

having, apparently, the same composition as the main mass, occurs on the Gold Hill group a short distance from the workings. With it is associated a dyke similar to those cutting the main granitic mass.

This granitic mass is believed to represent the southeastward extension of the Oliver granite of the Fairview camp. Although it has not been traced to Oliver, its general northwesterly trend if continued would carry it to the extension of the Oliver granite mapped by Bostock in his work on Similkameen and Okanagan valleys. The rock is somewhat more basic in composition than the Oliver granite. Daly shows the extension of this mass as being probably of Jurassic age.

Another group of granitic rocks, which have been mapped separately because their age relations were not determined, but which are probably closely related in age to the group of rocks described immediately above, is represented by two areas, one at the summit of Baldy mountain, and the other west of Conkle lake. These are grey, medium to coarse-grained, granitic rocks with quartz, feldspar, and mica visible with a hand lens. Under the microscope these rocks show fairly abundant quartz, abundant plagioclase (oligoclase-andesine), orthoclase or microcline, biotite and hornblende, and the common accessory minerals, magnetite, apatite, and zircon. In one specimen the plagioclase feldspar individuals show a well-developed zonal structure. Some of the specimens show micrographic intergrowths of the quartz and feldspar. The plagioclase feldspar is the most abundant of the rock constituents, followed in order by orthoclase or microcline, quartz, and the ferromagnesian minerals. These rocks fall into the general class of granodiorites. They are cut by dykes similar to those that cut the other granitic intrusives, and are overlain by volcanics in the vicinity of Rock creek.

Two groups of rocks occur that are not shown on the accompanying map. The first of these was found at one locality only, it occurs as a narrow band either at or close to the southern edge of the granodiorite that occupies the summit of Baldy mountain. This is a dark green to grey, coarsely crystalline rock, which weathers to a rusty brown, and to the eye is apparently composed very largely of pyroxene. Under the microscope the rock is seen to be composed very largely of pyroxene, with a little white mica in veins and small aggregates and a little chlorite as an alteration product. The only other mineral observed was magnetite in considerable quantity. The rock may be classed quite definitely as a pyroxenite. On account of overburden at the point at which it was found its relations to the granodiorite and to the schists could not be ascertained. The occurrence is strongly suggestive of a dyke or small, elongated stock near the contact of the granodiorite and the schist, but could equally well be a basic border phase of the granodiorite. Somewhat similar rocks, associated with the Similkameen granodiorite, were observed by Bostock in his mapping of the area between Okanagan and Similkameen valleys. Rocks of this type are also reported to occur in the area to the north of Baldy mountain.

The second group consists of the dyke rocks previously referred to in this report and which may be classed under the general term of feldspar porphyry. Although exhibiting some differences in texture and composition these are generally fine-grained rocks with crystals of feldspar in a dark, felsitic groundmass, but some types have a fine-grained, granitic ground-

mass. A typical specimen is from a sill 6 inches thick cutting biotite gneiss, and is a pale pink to flesh coloured, fine-grained rock with granitic texture. Quartz, white and pink feldspar, and mica are visible. Under the microscope microcline is seen to be the most abundant mineral, followed in order by large crystals of plagioclase which suggests a porphyritic habit, that is, two generations of crystals. Quartz is fairly common, and feldspar, shreds of biotite, hornblende, small individuals of apatite and iron ore make up the balance of the rock. A second specimen of a somewhat similar type shows large individuals of microcline and plagioclase with a few smaller individuals of pyroxene and biotite in a fine-grained, granitic groundmass of feldspar, perthite, pyroxene, biotite, apatite, iron ore, and a little chlorite. A third specimen, which is microscopically a fine-grained, dark grey rock with phenocrysts of feldspar, shows under the microscope large crystals of pyroxene and plagioclase in a microgranitic groundmass of quartz, orthoclase, plagioclase, and hornblende. The felsitic varieties show phenocrysts of plagioclase, and in some instances hornblende and pyroxene in a groundmass made up very largely of fine laths of feldspars, with some chlorite and magnetite.

These dyke rocks are very common. They are to be found in the schists of the Anarchist series, the rocks of the Osoyoos batholith, and the younger granodiorites. At points they are the only rocks that outcrop and the impression might easily be obtained that large parts of the area are underlain by them. Their actual areal extent, however, is judged to be small. They are believed to represent the final stages of batholithic intrusion.

Another group of rocks, which occurs in two areas in the vicinity of Rock Creek, consists of volcanics, which are deemed to be the most recent consolidated rocks of the area. These were noted only in the vicinity of Rock Creek. These rocks are generally dark in colour with a fine-grained to glassy groundmass with occasional phenocrysts of hornblende. Under the microscope the specimens examined show phenocrysts of hornblende in a devitrified groundmass. These rocks are somewhat dissimilar to the extrusive rhomb-porphry described by Daly as lying to the east of Rock Creek; their relations to the volcanics described by Daly as Miocene were not observed. They appear, however, to overlie the granitic intrusives in the vicinity of Conkle lake and are considered to be younger than them; and it is considered probable that they belong to a period of extrusion in the Tertiary.

Overlying the rock formations is a mantle of alluvium and glacial drift. This is thickest on the slopes of the ridges to the creeks, but over quite large parts of the area it is sufficiently thick to render outcrops scarce, even on the summits of the ridges. In the creeks a series of canyons connecting wider and drift-covered parts of the creeks afford continuous outcrops for short distances.

ORE DEPOSITS

The information obtainable with regard to the ore deposits is very meagre, due to the fact that a great part of the surface of the camp is covered with drift deposits and the underground workings of nearly all the properties are inaccessible owing either to the partial caving of shafts and adits or to the fact that many of the old workings are full of water.

The chief type of deposits consists of quartz veins occurring in the schists of the Anarchist series and in general paralleling the strike and dip of the schistosity. The general trend in Camp McKinney proper is east-west, but elsewhere veins running in many different directions were noted. These quartz veins are mineralized with pyrite accompanied by galena and zinc blende and carry in places good values in gold. Somewhat unsatisfactory evidence indicates that the gold values accompany the galena and zinc blende, but instances of heavy galena and zinc blende mineralization were noted where only low values in gold were reported. Where pyrite occurs alone in the veins the values are apt to be low. The amount of silification varies greatly from place to place along the strike of individual veins; in some cases bodies of quartz 5 or 6 feet wide narrow within a few feet to one or more stringers along the same strike. Although no definite evidence on this point was obtained, it appears probable that the ore occurs in shoots. The deposits present somewhat striking resemblances to the veins of Fairview camp.

In some instances quartz accompanied by the same mineralization appears as stringers, lenses, and bunches in shear zones. In some places, notably at the Dayton camp, shear zones in volcanics hold abundant disseminated pyrite accompanied by little or no quartz.

The principal veins seen occur on the northern side of the main mass of granodiorite. On the south side of this granodiorite there are, however, numerous veins and shear zones in the Anarchist schists carrying quartz and pyrite. No veins were seen in the granodiorite itself, but it is quite possible that veins do occur in this rock.

The only property being actively prospected at the time of the writer's visit was the Gold Hill Group owned by the Gold Hill Mining Company. This property consists of the Little Billy, Gold Hill Nos. 1, 2, 3, and 4, Paystreak Nos. 1 and 2, Allan, Mary, Douglas, and Evelyn claims, and is in part a re-staking of the former George Hurst, Dolphin, Bellvue fraction, and Bellringer No. 1 claims. The property is situated about a quarter of a mile to the west of the Cariboo-Amelia. On the Gold Hill a shaft at elevation of approximately 4,800 feet has been put down in a quartz vein a reported distance of 60 feet with 15 to 20 feet of crosscutting at the bottom of the shaft. These workings could not be examined as they were full of water. At the surface the vein is exposed and is 6 feet wide, strikes north 60 degrees west, and dips at 55 degrees to the southwest. The mineralization consists of pyrite occurring in small bunches and along fractures in the quartz. The vein is well jointed parallel to the strike and dip of the schists. About 600 feet southeast along the strike of the vein and approximately 150 feet lower in elevation, an adit 300 feet long has been run as a drift along the vein. In this stretch the vein strikes north 50 degrees west and dips 60 to 85 degrees to the northeast, that is in the reverse direction to that exhibited by the vein at the shaft. At the entrance to the adit the vein is 5 feet wide, but narrows within a few feet to a stringer. From here to the face the vein shows as one or more strands of quartz, which vary considerably in width. The mineralization seen consists chiefly of pyrite; galena and blende occur in spots, but the work done on the adit to the date of the writer's visit is reported to show no continuous ore shoot. At intervals between the adit and the shaft the vein has been picked up by open-cuts.

About half-way between the two workings a small body of feldspar porphyry and a dyke of the same rock run in a direction to intersect the vein, but their relations to it could not be observed.

Cariboo-Amelia. Very little could be seen of the mineral showings on this property which was the chief producer of the camp. This property was worked from about 1895 to 1903 and the following details were taken from the Annual Reports of the British Columbia Minister of Mines for those years. The production by years is given as follows:

1895..	\$104,861
1896..	131,223
1897..
1898..	152,800
1899..	146,410
1900..	160,831
1901..	137,024
1902..	131,324
1903..	82,500

It is stated that there were two parallel veins running in an east-west direction with a steep dip to the south; that ore was mined in places to a depth of 540 feet and over a length of 1,740 feet. The ore is stated to have had a rake to the east and according to reports was lost on a fault (B.C. Minister of Mines, Annual Report 1932). It could not be told without the mine plans whether the workings were on the faulted segments of one vein or on a series of veins. In the autumn of 1934 some diamond drilling was done on the property both below the old workings and on the extension of them, in the hope of picking up the ore beyond the reported fault, but this work is reported to have shown disappointing results. Sections of some of the drill cores examined by the writer showed that the area explored lay in the rocks of the Anarchist series. One small mass of granodiorite apparently lies to the south of the workings and a number of fine-grained, greenish dykes were encountered which showed disseminated pyrite and pyrrhotite.

The mouth of the shaft, on the Sailor claim, is now so caved that the vein outcrop could not be seen. Judging from the material on the dump the mineralization was the same as at the other properties, namely, quartz with pyrite and some galena and zinc blende. Part of the wall-rock consists of greenstone heavily altered to ankeritic carbonates and bright green chlorite; and part consists of quartzite. The shaft is reported to be 175 feet deep with levels at 75, 100, and 150 feet. On the 100-foot level, 200 feet of drifting was done and the vein is reported to average about 4 feet wide; on the lower level 140 feet of drifting was done, with the vein here reported much broken (B.C. Minister of Mines, 1901).

On the Minnihaha the vein apparently strikes east and west and dips about vertical. This is a quartz vein from 1 to 2 feet wide. According to old reports of the British Columbia Minister of Mines a shaft was sunk 200 feet with some 600 feet of drifting on the 100-foot level and 150 feet on the 200-foot level. This property was equipped with a mill, which it is stated ran for three weeks in March, 1900.

On a property presumed to be the Waterloo, the vein zone, where it could be seen, is about 4 feet wide and consists of a number of stringers

of bluish quartz in sheared greenstone. The strike of the zone is south 80 degrees east and the dip nearly vertical. There are two prospect shafts close together on this zone, one about 30 feet deep and the other 20 feet deep. The main working shaft some distance to the east is completely covered with debris.

A number of claims are held in what is known as the Lemon camp located around the lower part of Jolly creek. The Ogofan claim of the Gold Standard group lies on the north side of Jolly creek, a short distance from the point where the creek is crossed by the road. The showing on this claim consists of a shear zone 4 feet wide, striking north 35 degrees east and dipping 67 degrees southeast. The wall-rock consists of sheared greenstone of the Anarchist series altered to ankeritic carbonates and bright green chlorite. In the shear zone are stringers of quartz with pyrite, chalcopyrite, zinc blende, and malachite. The values found to date are reported to be low.

On the Ecuador claim of the same group, situated on the opposite side of the creek, a shear zone occurs in black schist between two walls of quartzite 4 feet apart. The strike is north 70 degrees east and the dip from 45 to 80 degrees southeast. The schist carries stringers and bunches of quartz from which very low values are reported.

On the Gold Standard of the same group an irregular lens of quartz 6 to 8 feet wide is exposed with walls of black schist with smaller veins of quartz occurring in either wall. The lens apparently follows the contortions of the schist. An adit 400 feet long has been driven into the hillside, and exposed a number of stringers and bunches of quartz which carry pyrite and some coarsely crystalline galena. The large lens of quartz occurring near the portal of this adit was not encountered in the workings. The values shown by sampling the quartz are reported to be low.

Some 400 feet downstream from these workings and still on the Gold Standard claim, a shaft reported to be 90 feet deep has been put down on a small quartz vein. Free gold was reported from this shaft.

A little farther downstream, still on the Gold Standard, a quartz vein outcrops. It is about a foot wide, strikes east and west, and dips 45 degrees north. This carries pyrite and galena and is reported to have yielded samples holding 0.2 to 0.3 ounce of gold to the ton.

On the Snowden claim, downstream from the Gold Standard, an adit has been driven 80 feet along a shear zone about a foot wide, carrying some quartz, pyrite, galena, and zinc blende, and reported to hold low values in gold.

Considerable development work was done in the past on the Victoria and Old England claims, which are adjacent to, but not part of, the Gold Standard group, and it is reported that several carloads of high-grade ore were shipped. Owing, however, to the fact that a slide covered the adit mouth the workings are inaccessible. For a description of the Victoria workings *See* the British Columbia Minister of Mines Report for 1897.

On the opposite side of the creek and slightly downstream from the mouth of the adit, a short adit has been driven 50 to 60 feet on a shear zone that is about 2 feet wide, strikes north, and dips 70 to 80 degrees east, and is approximately parallel, as far as could be judged, with the direction of the vein zone on the Victoria and Old England. For the greater part of the length of this adit only narrow stringers and kidneys of quartz appear.

Close to the portal there is a 6-inch stringer of quartz which rapidly narrows down to a seam. Values ranging as high as \$150 a ton are reported to have been obtained from this showing.

In the Dayton camp, which lies east of the McKinney road and south of Jolly creek, some difficulty was experienced in relating the various exposures to the mining claims. The exposures in general appear to be shear zones in volcanics and differ from the deposits of Camp McKinney proper in that they carry little or no quartz. The strike and dip of the zones vary considerably. The zones seen are, in general, from 3 to 4 feet wide and are impregnated with considerable amounts of ankeritic carbonates. Abundant pyrite is disseminated throughout the rock in the vicinity of the shear zones. The values obtained in this type of deposit are not known to the writer.

On the LeRoi (?) claim a quartz vein occurs in volcanics altered along the vein to ankeritic carbonates. The vein is not very well exposed in the cut where it was found, but is probably 18 inches wide, strikes about north 20 degrees east, and dips at 50 to 60 degrees southeast. Where seen the quartz is stained rusty brown, but no sulphide mineralization was detected.

To the south of the main granodiorite mass a number of shear zones carrying quartz occur in the schists of the Anarchist series and carry some pyrite and in cases chalcopyrite and galena. The latter mineral was not seen in place, but specimens reported to have been taken from zones in this neighbourhood, and exhibited to the writer, contained this mineral. The chief zones seen occur on the lower slopes of a hill to the northwest of Bridesville, not very far from the main highway, and are exposed by a series of cuts and shallow pits. The most westerly of these zones strikes north 70 degrees west and dips at 70 degrees northeast. It carries a small amount of quartz and apparently pockets of massive pyrite, but this mineral was not seen in place. On the dump, however, the excavated material shows abundant small masses of pyrite. The rock in the vicinity of the shear zone is heavily iron-stained.

Somewhat less than a mile west of Bridesville, a short adit at an elevation of 3,900 feet, on the slope of the same hill, partly exposes a shear zone with an approximate strike of north 65 degrees east and a dip of 45 degrees northwest. The adit is 10 to 12 feet long and the face is in a massive crystalline limestone. Towards the portal the country rock is schist cut by a dyke of fine-grained, dioritic rock. Both the dyke and the schist are impregnated with disseminated pyrite, a little quartz, and some chalcopyrite. In the schist are also round nodules of pyrite. No statement as to values may be made. Some 750 feet east and about 150 feet higher in elevation, another open-cut has been made on shattered and iron-stained rock. No sulphide mineralization was seen at this point.

At numerous other points silification of the schists was observed, but where seen the outcrops were apparently lacking in sulphide mineralization.

Placer Deposits. Time did not permit of examining in detail the various placer workings occurring on Rock creek and McKinney creek, and for descriptions of this work the reader is referred to the reports of the British Columbia Minister of Mines. A considerable amount of work has been done on both creeks within the past few years.

DIVIDEND-LAKEVIEW PROPERTY, OSOYOOS, B.C.

A short visit was paid to the Dividend-Lakeview property near Osoyoos. This group, consisting of eight claims and three fractions, is partly owned by Osoyoos Mines, Limited, and partly leased by that company from the Dividend-Lakeview Consolidated Gold Mining Company of Elmira, New York. For the early history of the property the reader is referred to the Annual Reports of the British Columbia Minister of Mines, more specifically to the report for the year 1913. The following brief summary may, however, be given. The property was first opened by George Nadin in 1901 with, however, little success. In 1908 it was optioned by Granby Consolidated Mining, Smelting, and Power Company, and considerable development was carried out, including the long crosscut adit on the Dividend claim. In 1911 the Dividend-Lakeview Consolidated Gold Mining Company acquired the property and shipments of eight carloads were made averaging \$17.14 a ton, to the Granby smelter at Grand Forks. Further shipments of eight carloads were made in the autumn of 1913, with an approximate average value of \$24.34 a ton. Prospecting and sampling of the property by the Northern Syndicate, Limited, of Calgary, was started in 1932 and the following year Osoyoos Mines, Limited, was formed to operate the property. During the summer of 1934 a great deal of preliminary work was accomplished, such as the building of a camp, laying of pipe to supply water to the property, and installing machinery; and it is reported that subsequent to the writer's visit some underground work was undertaken.

The field work done was of a preliminary nature only. Much additional information will be afforded by the development campaign now in progress. The writer was ably assisted in the field by Mr. J. M. Black. The writer also expresses his thanks to Mr. J. O. Howells, in charge of operations, for the many courtesies received as well as for the valuable information placed at his disposal.

The property is located on the eastern slope of Kruger mountain, to the west of Osoyoos lake and about a mile north of the International Boundary. The main transprovincial highway passes down the southern Okanagan valley to Osoyoos, and continuing south from here is a highway to Oroville, Washington, which passes within a short distance of the property. A good branch road connects the property with the main highway. Oliver is about 16 miles north of the property, and Penticton, on the main line of the Kettle Valley railway, is about 45 miles north. A branch line of this railway extends south from Penticton to Oliver. Oroville, Washington, which is about 6 miles south of the property, is served by the Great Northern railway.

Between the years 1901 and 1906 Daly mapped the geology in a strip along the International Boundary and this work was published (Memoir 38) by the Geological Survey in 1912. The regional geology was mapped by H. S. Bostock of the Geological Survey. The unpublished manuscript of this map was made available to the writer who wishes to acknowledge its assistance in relating the formations that occur in the vicinity.

GENERAL GEOLOGY

The oldest rocks in the vicinity are referred to the Anarchist series, which here include micaceous quartzites, mica and chlorite schist, crystalline limestone, and greenstone. The distribution of this group is shown on the accompanying map. These rocks, with the exception of the limestone, are prevailingly dark in colour, and are quite generally highly sheared. They have a general northerly strike and a prevailing dip at low angles to the west. The quartzite is a dark grey to green rock, and is commonly sheared so as to resemble the dark grey schists. These rocks were not examined under the microscope. The limestone members occur as small lenses or pods which can never be traced for any considerable distance. They are blue-grey to nearly white rocks and examination of some under the microscope in connexion with the ore deposits shows that recrystallization is complete. The beds they represent were probably sheared into the remnants now found during the folding and shearing of the enclosing rocks. The greenstone members vary from fairly massive to schistose dark green rocks and are intimately associated with the sedimentary members of the series. They probably represent extrusive rocks which were sheared along with sediments of the Anarchist series. Those specimens examined under the microscope show almost complete alteration to secondary minerals. Abundant chlorite, secondary quartz, calcite, and some lime silicates make up most of the rock so that very little can be said of their original constitution.

A second group shown on the accompanying map as altered diorite consists of fine-grained, dark green rocks, which with the hand lens show an apparent holocrystalline texture with feldspar and ferromagnesian minerals visible. Under the microscope, however, the rocks are seen to be very largely altered to secondary minerals, so that very little can be seen of the original structure. Hornblende and chlorite make up much of the rock, with some pyroxene, and plagioclase feldspar which exists largely as "ghosts" amongst the alteration products, and some secondary quartz. The feldspars could not be determined. It is believed that the rocks possessed holocrystalline idiomorphic texture, but this is uncertain. They are believed to represent basic to semi-basic types, that is, diorite to gabbro, possibly intruding the Anarchist series and having undergone metamorphism with them as did the greenstones, but which represent extrusive rocks associated with the Anarchist series. On account of the likeness of these rocks to the greenstones their separation on the accompanying map is admittedly incomplete, and possibly they should be included with the Anarchist series as defined by Daly.

The rocks shown on the accompanying map as belonging to the Osyoos batholith are medium to coarse-grained, grey to greyish green, with a granitic texture, but show in many places a decided gneissic structure. With the eye, quartz, feldspar, and hornblende can be detected. Under the microscope the specimens selected for examination showed fairly abundant plagioclase feldspar, highly altered to sericite, but of about the composition of andesine. The plagioclase is the most abundant mineral of the rock. Orthoclase is present, but only in minor amounts. The ferromagnesian mineral is almost entirely altered to chlorite, but probably con-

sisted of hornblende. White mica, iron ore, and calcite make up the balance of the rock; the latter occurring in numerous veins cutting across the specimens and also as an alteration product. The quartz shows pronounced granulation and recrystallization. The rocks fall within the class of granodiorite to quartz diorite.

Another group, not shown on the accompanying map, occurs several miles to the west. This is an assemblage of plutonic rocks shown by Bos-tock in his mapping to consist of syenites and granodiorites. These form a large mass on the slope to Similkameen river.

ORE DEPOSITS

The ore-bodies are typical high temperature replacement deposits developed at some distance from the intrusive which gave rise to them. The larger appear to follow the lime beds of the Anarchist series, or the altered volcanics of the same series, which also contain considerable lime. They occur chiefly as irregular replacements of the country rock, but also as veins along fissures and joints. The chief metallic minerals are pyrrhotite, magnetite, and chalcopyrite with some arsenopyrite and they occur in a gangue of altered limestone or of altered volcanics, which has developed in it the typical silicate minerals garnet, epidote, diopside, wollastonite, and possibly others. Pyrrhotite is the most abundant of the ore minerals, and magnetite is common at some points; chalcopyrite varies greatly in amount from point to point; and arsenopyrite also varies greatly in amount. It is believed that this latter mineral carries the larger part of the gold values, as these seem high wherever this mineral has been detected. Considerable parts of the large masses of pyrrhotite hold only low values in gold and it is possible that the arsenopyrite is a later phase of the mineralization than the pyrrhotite. Polished sections of the ore were not studied for this report to secure the order of deposition of the sulphides. It is evident from the thin sections examined that the sulphide mineralization followed in general the development of the lime silicate gangue, for inclusions of the lime silicates appear within the sulphides, and veins of the sulphides traverse the altered rock.

The dimensions of the ore-bodies are unknown as development work has not progressed to the stage where it can be definitely asserted that the full width or length of the ore-bodies are shown by the present workings. At one place on the Dividend an ore shoot has been stoped out for a depth of about 60 feet on the pitch, is about 50 feet long, and varies from a few feet to 20 feet in thickness.

It is not known with which of the intrusive rocks of the vicinity the ore deposits are genetically connected. The small masses of altered diorite or gabbro in the vicinity of the ore deposits are not believed to be the source of the ore, as these are altered nearly to the same degree as the country rock of the deposits themselves. It is consequently believed that the deposits were formed some little distance from the igneous rocks that furnished the ore solutions, and the most probable source of the mineralization is deemed to be the rocks of the Osoyoos batholith. The contact of these granitic rocks is some 800 to 2,500 feet from the various

deposits, and beneath the surface may possibly reach somewhat closer. The attitude of this contact below the surface is not known, but it probably slopes somewhat in a southerly direction, which would tend to bring these rocks beneath the ore deposits, at an unknown depth. There is also a possibility that the ore deposits may be related to the large mass of plutonic rocks occurring on the Similkameen slope of Kruger mountain, previously referred to. The nearest outcrops of these rocks are, however, several miles west of the deposits, and unless they project beneath the surface in an easterly direction for a considerable distance they would in all probability be too remote to form mineral deposits of the high temperature type under discussion.

Many deposits of the quartz vein type occur in the neighbourhood, but these are not being developed at the present time, and were not investigated.

Dividend Claim. The main ore-body on this claim is situated about 400 feet from the eastern edge of the claim and about 600 feet from the northern edge, on a small flat at the top of a steep cliff. A short adit has been driven southeasterly into the body and the ore removed from a stope, which is roughly 60 feet long and 16 feet wide, and has been broken through to the surface. The floor of this level is roughly 40 feet below the top of the stope. At 18 to 20 feet below this level an intermediate level, known as No. 1 level, has been driven in a general east-west direction, and connected with the stope by a winze. The eastern end of this level projects some 25 feet beyond the stoped area and is shown by sampling to be in good ore. Towards the western end, the level swings to the southwest and projects in this direction some 30 feet beyond the westerly face of the stope. This face is also in good ore. An ore-pass connects with No. 2 and No. 3 levels. No. 2 level is about 30 feet below the intermediate level. It also has been driven in an east-west direction being 56 feet long from the ore-pass in an easterly direction and 38 feet long in a westerly direction, with a short crosscut to the foot-wall side of the ore-body about half-way along this western drift. The third level is 100 feet in elevation below No. 2 level, or approximately 190 feet below the outcrop. This is an adit that serves as the main haulage level and has been driven in a southeasterly direction to a point vertically below the other workings. A number of crosscuts lead off from it. The first follows an easterly direction, takes off at 258 feet from the portal, is 40 feet long, and at the end is joined by the ore-pass from the upper levels and by a crosscut 48 feet long driven to the southwest. At 320 feet a second crosscut has been driven to the east for 60 feet, and another 20 feet long has been driven to the southwest.

The principal ore shown is on the walls of the stope and in No. 1 level. Some ore also occurs on No. 2 level. Sampling of the walls of No. 1 level is reported to show an average value of nearly 0.67 ounce in gold over an average width of 5 feet and a length of 120 feet. Values running up to 3 ounces of gold are obtained locally. On the walls of the stope the values obtained are somewhat lower, but still of commercial grade, making it appear that the walls of the deposit have not yet been reached. On the second level the ore encountered is still lower in grade; here, however, the

ore has been faulted and its extension beyond the fault has not been picked up. The third level does not show any ore. This level was run apparently with the idea of picking up the downward extension of the ore-body, but this has not yet been found.

The ore of the Dividend claim follows, in part at least, one of the limestone remnants of the Anarchist series. Under the microscope the calcite of this rock is to be seen abundantly replaced by silicate minerals, epidote, garnet, diopside, and wollastonite being those identified. The sulphides seen in thin section, chiefly pyrrhotite, are somewhat later than the development of the silicate minerals, for these occur as inclusions in the sulphides.

Manx Claim. The Manx workings are situated at the extreme eastern edge of the claims, at the top of a talus slope lying beneath a steep bluff nearly 100 feet high. The workings consist of an adit running west for 112 feet. About 24 feet from the face a short crosscut runs to the southwest for 32 feet and then turns and parallels the main adit for 16 feet.

Near the portal the wall-rock consists of altered greenstones in which there is a zone of intense pyrometasomatism, with an abundant development of silicates, chiefly garnet and epidote. Some sections of the rock examined under the microscope were seen to consist almost wholly of garnet and secondary silica. In general the rock in this vicinity consists almost entirely of secondary minerals, chlorite, quartz, diopside, and wollastonite, in addition to garnet and epidote. At the portal of the adit there is a narrow vein of decomposed material, containing much quartz, striking south 5 degrees east and dipping 60 degrees to the southwest. The adit passed through this seam and did not encounter much mineralization until a point near the crosscut was reached. In the crosscut sulphide mineralization with gold values is found almost continuously along both walls to the face. The values are highest on the north wall and range from 0.09 to 0.33 ounce a ton, these values holding over widths slightly in excess of 5 feet. On the south wall the values are slightly lower and range from 0.05 to 0.14 ounce a ton. In the crosscut the ore is cut by a fault striking north 5 degrees west and dipping 65 degrees to the northeast. The main adit follows a fault striking north 70 degrees west and dipping 55 degrees northeast. The ore encountered in the crosscut consists chiefly of pyrrhotite, but the work done to date does not give any conclusive data as to its dimensions.

On the flat at the top of the bluff mineralization, consisting of pyrrhotite and chalcopyrite with malachite and azurite, has been found at a number of points distant 1,000 to 1,500 feet from the Manx tunnel. These showings have been opened by a number of shallow cuts.

As the zone of alteration around the bluff near the Manx tunnel is a wide one, considerable prospecting in this vicinity is justified in the hope of encountering further ore.

Lakeview Claim. The Lakeview workings are situated about 400 feet from the eastern edge, and 600 feet from the northern edge, of the claim and consist of a main adit 166 feet long running nearly south, with a number of crosscuts. At a point in the adit 112 feet from the portal, drifts have been

run both east and west along the direction of the ore. The west drift is 120 feet long. The east drift is 100 feet long with a crosscut 50 feet in length, near its end. Near the end of the drift a short raise has been put up. At the intersection of the main adit and west drift a winze has been sunk and in the west drift, at 100 feet from its entrance, a second winze has been sunk. The depth of these winzes is not known to the writer. They are presumed to be connected with the lower workings, but this is uncertain. From the first of the two winzes, and on the same level with the main adit, a crosscut has been driven in a southwesterly direction for 130 feet. At the end of the main adit a short westerly drift has been driven to connect with this southwesterly crosscut and this drift has also been continued a short distance to the east: from this drift a raise has been put through to the surface approximately 100 feet above; and from the end of the main adit a short northwesterly crosscut makes a second connexion with the southwesterly crosscut from the first winze.

From a lower level on the hill, and about 300 feet distant from these upper workings, a second adit has been driven in a westerly direction to get under these workings and, apparently, to hit the ore at a lower horizon. This was caved and inaccessible, and it consequently could not be determined whether this adit connected with the upper workings or not, and whether it was successful in cutting the ore at this level. In the report of the British Columbia Minister of Mines for 1913 reference is made to the lower workings, presumably this adit, and the report states "all . . . the drifts and crosscuts from this tunnel appear to be under the ore-body. The ore-body may have a downward extension but so far it has not been discovered."

The ore-body as exposed in the workings is irregular in shape and speaking generally the values in gold are low. The former operators estimated that these workings put in sight between 40,000 and 50,000 tons of ore with an average value of \$4 a ton in copper and gold (British Columbia Minister of Mines, Annual Report 1913, page 173). Mineralization appears in many of the headings, but the sampling of the workings was incomplete at the time of the writer's visit and had been confined chiefly to the main adit and to the east and west drifts therefrom. The mineralization is pyrrhotite, chalcopyrite, and magnetite with some arsenopyrite in a gangue of altered limestone and greenstone well impregnated with lime silicates. In the west drive an ore shoot is indicated by the sampling on the north wall. Here there is heavy sulphide mineralization in a highly crushed and sheared zone in the country rock. This zone is about 60 feet long and sampling over widths of from 3 to 6 feet indicates gold values ranging from 0.09 to 0.66 ounce. A short stretch of 20 feet shows values well above the average of this section. On the south wall of the drift the values are lower.

In the east drive there is considerable sulphide mineralization in the walls of the drift. Sampling has shown gold values ranging from \$1 to \$4 a ton over widths of from 3 to 6 feet, calculated at \$30 an ounce.

In the main adit, across a width of 40 feet immediately to the north of the east-west drift, low values in gold are shown.

A fairly large body of ore is, therefore, indicated and much more information with regard to it will probably be made available as the remainder of the workings are cleaned out and rendered accessible. It is

judged that the ore-body here lies fairly flat, following the rocks in which it occurs, and that the ore deposition is probably controlled to some extent by the structure of the beds in which the ore occurs. Outcrops of rock are rather scarce in the vicinity of the Lakeview workings; but with all the mine workings accessible, it will probably be possible to work out the detailed structure. The occurrence of one shoot of ore with good gold values justifies further exploration of this ore-body in the hopes that others will be found.

Mineralization was also encountered on the Treasury claim during the course of assessment work, but this occurrence was not examined.

A number of quartz veins were seen in the vicinity of the Osoyoos Mines property. These were not examined in detail, but appeared to follow fault zones in both the quartzites of the Anarchist series and in the granitic rocks of the Osoyoos batholith. One to the south and east of the Dividend occurs where a fault intersects the quartzite. Near the fault the quartzites show considerable silicification with a small amount of copper carbonate visible in the rock. To the northeast of the property a shear zone in the rocks of the Osoyoos batholith shows considerable quartz with iron and copper sulphides, the whole being heavily stained with copper carbonates.

VIDETTE LAKE AREA

About three weeks of the field season of 1934 was devoted to a study of the geology and ore deposits of Vidette Lake area, situated north of Savona in Ashcroft mining division. The chief producing property of that area, Vidette Gold Mines, Limited, was acquired under option by D. B. Stirrett and associates about 1931. After preliminary prospecting the property was turned over to Vidette Gold Mines, Limited, of Vancouver, and the success attending the development of this property has led to considerable prospecting of the area.

The area being prospected is situated about 45 miles north of Savona, a village at the lower end of Kamloops lake. The Thompson valley is here served by both the Canadian National and Canadian Pacific railways and is also traversed by the provincial highway between Vancouver and Kamloops. The road to the property leaves the provincial highway a few miles west of Savona, and passes up the valley of Deadman river to Tobacco flats, a distance of some 25 miles. Here the road leaves the valley and passes over the hill to Vidette lake. This latter part of the road, about 17 miles in length, is in very poor condition, and at the time of the writer's visit a new road was under construction, following the valley of Deadman river from Tobacco flats to Vidette mine. This is now reported to have been completed.

A large reconnaissance map of Kamloops area made by Dawson in 1894 shows the regional geology of Kamloops area and the geological formations are described in the accompanying report.¹ Descriptions of Vidette Gold Mines, Limited, have also been published in the reports of the British Columbia Minister of Mines.²

¹ Dawson, G. M.: Report on the Area of the Kamloops Map-sheet; Geol. Surv., Canada, Ann. Rept., vol. VII, pt. B (1896).

² B.C. Minister of Mines. Annual Reports 1931, 1932, 1933.

In the course of the field work only a limited area around the mineral properties was mapped. The writer was ably assisted in this work by J. M. Black and T. W. McGinn. The writer also expresses his thanks to the management and staffs of the various properties examined for the information placed at his disposal and for the many courtesies received during the progress of the work. Particular mention should be made of Mr. H. A. Rose, superintendent of Vidette mine, and Messrs. E. Inglis and J. Bennett of Savona Gold Mines, Limited, and Hamilton Creek Mines, Limited, respectively.

TOPOGRAPHY

The area lies within a lava plateau into which the main valley, occupied in part by Deadman river, Vidette lake, and Hamilton creek, has been cut. The plateau is a somewhat gently rolling upland tract, of which a large part is underlain by nearly horizontal lava flows. The main valley mentioned above is a narrow, deep trench with steep, and in places precipitous, walls, cut into this plateau, and exposes the rocks underlying the lava flows. It is on the walls of this valley that most of the mineral exposures have been found. The tributary streams entering the main valley do so through narrow canyons. At the southern end of the area mapped, Deadman river enters this main valley from the east, plunging in a fall about 100 feet high, formed by the horizontal lava flows, into a narrow gorge through which it flows a short distance to the main valley. Almost vertical cliffs of basalt mark the walls of the upper part of this canyon.

The plateau surface in the vicinity of Vidette lake is well covered with glacial debris, so that outcrops are comparatively scarce. Much of the area mapped during the course of this investigation apparently consists of an island of older rocks within the area of the lava flows. Outcrops along the walls of the main valley and along the lower part of tributary valleys entering it are very numerous.

GENERAL GEOLOGY

The oldest rocks of the area consist of a group of greenstones which have been referred by Dawson to the Nicola formation, and which he classes as Triassic, but which include, also, some Jurassic members. The greenstones are generally fine-grained, massive, greenish rocks, but in places show a porphyritic texture with phenocrysts of augite or hornblende and feldspar. In places they are highly sheared and might be termed chlorite or mica schists. Typical specimens examined under the microscope show crystals of hornblende and augite, and ghosts of feldspar crystals now almost completely altered to secondary minerals in a very fine-grained groundmass, which may have been in instances originally a glass, but in most instances shows minute laths of feldspar. Those facies that appear to the eye porphyritic appear to grade imperceptibly into the fine-grained greenstones. The sheared members were not examined under the microscope, but the shear zones are almost invariably accompanied by the development of ankeritic carbonates and some quartz, and have in places been prospected.

A second group of rocks, which in the area under discussion are represented only by dykes and minor intrusions, consists of granitic rocks. These are generally slightly greenish, grey, or purple rocks with a porphyritic texture, or a granitic texture; the porphyritic varieties have, however, a fine-grained, granitic groundmass, with visible feldspar, in some cases quartz, and hornblende or mica. The specimens examined under the microscope showed abundant albite-oligoclase, fairly abundant orthoclase, a little quartz, hornblende and chlorite, and some sericite, and would fall into the class of granodiorites to monzonites.

These are intrusive into the Nicola greenstone, but their relations to the other rocks of the area were not disclosed. It is shown, however, by Dawson's regional survey, that these granitic rocks are older than the Tertiary rocks which overlie the greenstones. No large or important areas of these rocks were found in the vicinity of the ore-bodies. Northeast towards Bonaparte lake and southeast towards Uren's, Dawson mapped somewhat more extensive bodies of granitic intrusives than were found in the area around the ore deposits, which would lead to the belief that the Nicola greenstones were extensively invaded by granitic rocks and that the bodies found in this small area represent apophyses of larger intrusive bodies.

TRANQUILLE BEDS

Overlying the Nicola formation and overlain in turn by the flat-lying basalts there is a thin series of beds, found at one point only, namely the canyon of Deadman river immediately below the falls. These beds are judged similar to those described by Dawson from other points along Deadman river where they overlie the Nicola formation and underlie the basalts. Dawson correlated these with the Tranquille beds and referred them to the Miocene. These consist of fine, slightly coherent, thinly bedded sandstones, fine, sandy conglomerates containing only a few, small, well-rounded pebbles and a considerable amount of tufaceous material. These are prevalently light coloured, yellow to white, and they form a conspicuous feature on the walls of the canyon. At the point where seen, the beds have a thickness of about 100 feet, a general east-west strike, and dip at a very low angle to the north. On account of their slightly coherent nature they form talus slopes or slides of this light coloured material. A few fragments of fossil leaves were recovered from these beds. These were submitted to W. A. Bell of the Geological Survey who reported as follows: "There are three species of fossil leaves in the collection but they are all too fragmentary to permit of identification. The best preserved of these is probably an *Ulmus* with simply dentate leaves not unlike *Planera nervosa* Nowberry from the Green River Eocene or some of the Arctic "Miocene" leaves referred by Heer to *Planera ungeri*. Little can be said about the other fragments. One is a doubtful, small-leaved *Quercus* recalling *Quercus uglowi* Berry, the other a small *Sapindus*-like leaf which does not show the pattern of the veins.

"On the whole the fragments are presumably remnants of a dicotyledonous temperate flora and there is nothing present to invalidate an assumption that this flora was contemporaneous with that from Kitsilano and Burrard inlet described by Berry and assigned by him an Upper Eocene or early Oligocene age."

BASALTS

The flat-lying basalts, which overlie these early Tertiary sediments, form in places a conspicuous escarpment at the edges of the valley walls. In the area under discussion the basalt, however, appears to be lacking in a considerable part of the country mapped, which lies to the east of the major valley in which Vidette lake is situated. The basalt, however, was found in the southern part of the area east of this valley. It would appear that an island of the older rocks exists in this vicinity within the basalts. Where seen the basalts consist of several individual flows with a total thickness of about 100 feet. These observations were made, however, close to the valley walls where it is probable that part of this rock has been removed by erosion, and the thickness may have originally been greater than that figure. The rock is generally black and fine-grained, with flow structure developed in places. Amygdules occur, but are not very common, and where present are filled with secondary minerals. Those specimens examined under the microscope showed occasional phenocrysts of labradorite in a fine-grained groundmass consisting of minute laths of feldspar, augite, and iron ore. The laths of feldspar appear to be included in larger augite individuals.

Although no definite evidence was obtained it is believed that the Tertiary lavas are younger than the period of mineralization represented by the gold quartz veins, and that search for mineral deposits of this type should be confined to the areas of older rocks. The distribution of such areas of older rocks for the entire district is shown on Dawson's map, and the areas over which prospecting for veins of this type should be undertaken in this general region have consequently been outlined.

ORE DEPOSITS

The chief ore deposits of the area consist of narrow but fairly continuous quartz veins which occur in the greenstone of the Nicola formation. The veins strike in a northwesterly direction and dip at angles of 45 to 70 degrees in a northeasterly direction. The width of those veins seen averages probably under, rather than above, a foot; however, those portions of veins on the Vidette property that constitute ore shoots would average probably 14 to 15 inches wide. The mineralization consists of quartz and pyrite, with some chalcopyrite and tellurides. The latter were found at one point only, namely in the north drift of the second level of Vidette mine. They have been reported from other points, but none was seen at these points by the writer. The ores are valuable chiefly for their gold content, and the average grade maintained in the ore shoots of Vidette mine is reasonably high. The only property with extensive workings is that of Vidette Gold Mines, Limited, and on this property post-mineral faulting constitutes a serious problem. The main vein being developed is split into a series of fault blocks, which complicate the problem of developing it. The faults generally appear to be of the normal type. Veins of calcite appear in places, and so far as known these are in general somewhat later than the quartz

veins and have not yet been proved to carry important values. In places ankeritic carbonates occur along the veins as alteration products of the greenstone.

In parts of the area strong shear zones have been developed in the Nicola greenstones, converting these to schists, and in many cases these zones carry veinlets, stringers, and bunches of quartz. The wall-rock in such cases is almost invariably heavily altered to ankeritic carbonates, and is impregnated with disseminated pyrite, but it is believed that the values so far obtained in the prospecting of such zones are low.

At a few localities the greenstones carry numerous stringers of calcite and feldspar, mineralized with chalcopyrite, and in one case, with specular hematite. The continuity of these zones has not been proved.

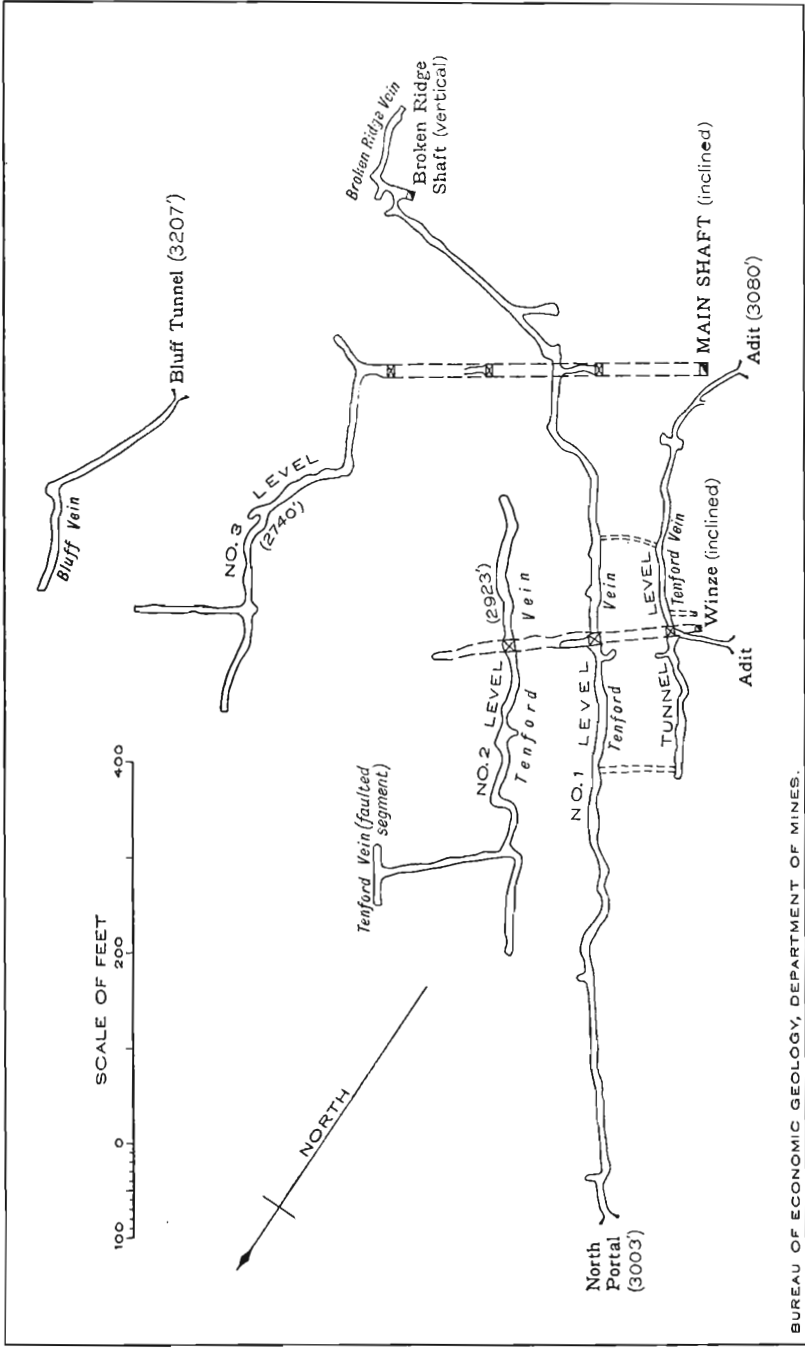
The veins fill fault fractures in the Nicola greenstones. The cause of the fracturing is not definitely known, but the small bodies of granitic rocks occurring in the vicinity have already been referred to as possibly apophyses of a batholith that does not appear at the surface in the area examined, and it is possible that the fracturing took place as a result of stresses developed during this intrusion. If such be the case the mineral solutions were probably derived from this granitic magma. The occurrence of plutonic rocks elsewhere in the district has already been pointed out.

Vidette Gold Mines, Limited. The group of claims being prospected by this company consists of the Searcher Nos. 1 to 8, Searcher fraction and Searcher fraction Nos. 1 and 2, Comstock, Wabbly, Thomas Paine, Monument, Myrta, Percy, New Hope, Valley Nos. 1 and 2, White Pass, and Vidette fraction. The location of these claims is shown on the accompanying map.

The main workings of the Vidette property consist of two shafts, a winze, and four levels (See Figure 1). A vertical shaft known as the Broken Ridge is about 80 feet deep and reaches No. 1 level. The Main shaft, an incline, situated 360 feet west of the Broken Ridge shaft, is approximately 460 feet deep measured along the slope, or somewhat over 300 feet deep vertically, and connects with No. 1 and No. 3 levels. The winze located 260 feet northwest of the Main shaft is also an incline driven from the surface approximately 350 feet deep measured along the slope, or 235 feet vertically, and connects the Tunnel No. 1 and No. 2 levels. The winze continues 75 feet below No. 2 level measured along the slope.

The Tunnel level is an adit, at elevation 3,080 feet, entering from the hillside a short distance below the collar of the main shaft, and is driven in a northeasterly direction about 100 feet to the Tenford vein and then northwesterly along its strike. At 300 feet from the portal it connects with the winze and from this point a short branch has been driven southwest to the surface, forming a second adit. From the winze the level has been continued northwest along the vein for 150 feet. Stope raises have been driven from No. 1 level to the tunnel level both north and south of the winze, and stoping of the block of ore between these two levels was in progress at the time of the writer's visit.

No. 1 level, at elevation 3,003 feet, has been driven northwest from the main shaft approximately 275 feet along the Tenford vein to connect with the winze and continues along the vein beyond the winze in this direction for 600 feet to a point where it emerges at the bottom of the hill slope,



BUREAU OF ECONOMIC GEOLOGY, DEPARTMENT OF MINES.

Figure 1. Plan of workings, Vidette Gold Mines, Limited, Lillooet district, B.C. August, 1934.

forming an adit known as the North Portal. From the main shaft it has been driven 240 feet in a direction just slightly south of east, to connect with the Broken Ridge shaft, and a short crosscut from this shaft enters the vein from which a drift has been run 80 feet along the Broken Ridge vein in a southeasterly direction.

No. 2 level, at elevation 2,923 feet, has been driven from the winze southeast 150 feet and consequently does not connect with the main shaft, and northwest from the winze for 210 feet. In the winze below the No. 2 level the Tenford vein was found to be faulted and a crosscut was accordingly driven from the northwest drift of No. 2 level, 200 feet from the winze, into the hanging-wall of the vein northeasterly for 140 feet, at which point the faulted segment of the vein was picked up and short drifts run along it in both directions.

No. 3 level, at elevation 2,740 feet, was driven to pick up the faulted segment of the Tenford vein. This level runs northwest for 100 feet from the bottom of the shaft, and then turns and runs northeast for 125 feet and then northwest for 180 feet. The vein, however, was not found in its projected position and consequently a crosscut 120 feet long was run northeast, from which some diamond drilling was done. This work, however, did not pick up the extension of the vein, which apparently has been repeatedly faulted. From the bottom of the shaft a crosscut had been started in a direction just slightly south of east to pick up the Broken Ridge vein.

Some 550 feet northeast from the main shaft, at an elevation of 3,207 feet, an adit known as the Bluff tunnel has been driven 160 feet northeast as a crosscut and then as a drift for 110 feet northwest along the strike of the Bluff vein.

On the western side of Vidette lake, two short adits have been driven on a vein known as the Dexheimer.

The main vein of the property, known as the Tenford, has a general strike of about north 35 degrees west and dips to the northeast at about 50 degrees. Although relatively narrow the vein is remarkably persistent and has been drifted on in the workings for a distance of 900 feet on the first level. At its southeast end it is cut off by a strong fault zone, which appears in the Tunnel level near the point where the first adit encounters the vein, and also in No. 1 level in a crosscut a short distance southeast of the Main shaft. In its northwest extension the vein splits up into a number of strands or stringers, which in places carry high values; in some places re-uniting to form a single narrow vein, but in spite of this condition it persists as far in this direction as the underground workings have been carried. The drifts on the Tunnel and on No. 2 level have been carried northwesterly only to the points where this splitting occurs, but on the No. 1 level, as already pointed out, drifting along the vein was carried to the point where the drift emerges at the surface. Beyond, the vein probably passes under the drift-covered area of the valley. The No. 2 level at the time of the writer's examination had not been continued to the fault that marks the southeastern termination of the vein.

The section of the vein on No. 1 level, which may be considered as an ore shoot, runs from the winze northwest about 250 feet and southeast from the same point 150 feet. This part of the vein is generally between 1 foot and 1½ feet wide, but parts of it that are, however, generally short

range up to nearly 4 feet. Towards the No. 2 level the vein flattens and in the winze below that level was found to be faulted. The crosscut driven into the hanging-wall of the vein from the northwest drift of the No. 2 level picked up the faulted segment of the vein which there had its normal attitude. This fault would appear to be a normal one with a horizontal displacement of 125 feet. With the information thus obtained the No. 3 level was run to pick up the vein at its projected position, but failed to do so. A crosscut to the east from this level also failed to pick up the vein, and some diamond drilling here also proved disappointing. In the crosscut a series of faults occur which make it appear that the vein has entered a broken section of ground and is probably stepped over successively towards the east in a series of fault blocks.

The Broken Ridge vein is exposed only in a short segment, approximately 80 feet long on No. 1 level, lying between two faults. This is believed to be the southeast extension of the Tenford vein, carried to its present position by faulting. It strikes about north 20 degrees west and has about the same dip as the Tenford vein, and where exposed on the level is moderately wide and constitutes high-grade ore. On account of the strike and dip of the two faults that form the limits of this vein, this fault block should lengthen somewhat in depth. The fault between the Tenford and the Broken Ridge veins may be also regarded as a normal fault with a horizontal displacement of about 220 feet. At the time of the writer's visit a crosscut to the Broken Ridge vein from the bottom of the main shaft had been started on the No. 3 level. Although the results of this work are not definitely known to the writer, it is reported that granitic dykes were encountered at the projected position of the vein.

The vein exposed in the Dexheimer tunnels on the opposite side of the lake shows an average strike of north 40 degrees west and a dip of 40 to 45 degrees to the northeast. The two adits are quite short and the vein as exposed in them is generally narrow and shows a tendency to split into a number of stringers. This vein is at present believed to be the continuation of the Tenford and Broken Ridge vein beyond the Broken Ridge fault block.

The Bluff vein as exposed in the workings varies from a seam to a vein of quartz nearly 12 inches wide. Its strike is north 50 degrees west and it dips at 40 degrees northeast. At the face of the drift the vein narrows to a seam. The joints of the rock here show strong movement as the joint planes are more or less polished.

The Stevenette vein is also a quartz vein with a strike of north 70 degrees west and a dip of 50 degrees northeast and is exposed on the bluffs overlooking the north end of the lake. It is about a foot wide and as yet has not been prospected.

The mineralization of the veins in general consists of quartz, with pyrite and some chalcopyrite. In places, however, tellurides appear. In the north drift on the No. 2 level specimens of tellurides were obtained. A specimen was submitted to the Mineralogical Division of the Geological Survey for determination. H. V. Ellsworth reports the specimen to show a silvery grey mineral which is indicated by chemical tests to be essentially bismuth telluride. It is assumed the mineral may be either tetradymite, joseite, or wehrlite, but specific determination had not been com-

pleted at the time of writing this report. A number of small faults appear in the workings of Vidette mine. Some of these carry calcite mineralization, but, so far as could be ascertained, no values. It is, therefore, believed that in general the calcite mineralization followed the gold quartz mineralization. High values in gold appear with the chalcopyrite, and also with the tellurides.

The faulting, which complicates the mining of the Tenford vein, appears to be very largely of the normal type, but the lack of members that might serve as horizon markers in the country rock, other than the vein itself, renders the relation of the various fault blocks difficult. It would appear that the Tenford vein is stepped over successively to the east. It is considered likely that similar faulting will appear in surrounding properties as these are developed.

In the annual report of the company for the period between May 1933 and September 30, 1934, the following information is given: ore produced, 5,681 tons, of which 1,015 tons were secured from development; ore milled, 5,427 tons with a content of 3,070 ounces of gold, 5,238 ounces of silver, and 6,444 pounds of copper.

Savona Gold Mines, Limited. This company is prospecting a group of claims lying north of the Vidette Gold Mines, Limited. The workings consist of a number of open-cuts and two short adits. A number of diamond drill holes have been put down to trace the course of the veins. The principal showings occur on the precipitous eastern slope of Hamilton creek, which enters Vidette lake from the north. The principal exposures lie on the Last Chance and Lone Shoe mineral claims. Three veins have been found on the steep slope, the highest or easternmost being known as the Jarvinen which has a strike of north 49 degrees west and a dip of 45 degrees northeast. This is a narrow quartz vein in a strongly sheared zone in the greenstone. It has not been developed by underground workings.

The central vein, known as the Sylvanite, outcrops from 50 to 75 feet below the Jarvinen vein. This is also a narrow vein with an approximate strike of north 32 degrees west and a dip of 71 degrees northeast. Where exposed on the surface it consists of banded quartz and ankeritic carbonates. This vein has been cut in the underground workings and drifted on for 110 feet. A vein believed to be the extension of this has also been reported from five diamond drill holes to the northwest, indicating a vein length of 600 feet. Outcrops extending northwest and southeast for a further total distance of 3,000 feet have been tentatively correlated with this vein, pending further development work. The lowest vein is known as the Argentite. This has a strike of north 30 degrees west and a dip of 70 degrees to the northeast. It is a narrow quartz vein with abundant ankeritic carbonates. Tellurides with very high values in gold were reported from this surface outcrop, but none was seen by the writer, the metallic minerals present consisting of pyrite and galena.

The main crosscut adit is about 200 feet long with a drift of 110 feet at the end to the southeast. At 170 feet from the portal a quartz vein about a foot wide, with included country rock, was encountered. This strikes north 40 degrees west and dips at 40 to 45 degrees and has a steeply inclined

stringer of quartz entering it from above. This has been temporarily correlated with the Argentite vein above. Tellurides were also reported from this point, but none of this mineral was seen by the writer. At the end of the crosscut adit a vein correlated with the Sylvania vein was encountered. This has the same strike and dip as on the surface and consists of a crushed zone well mineralized with lenses and stringers of quartz with some ankerite. Pyrite constitutes the only metallic mineral noted by the writer. Drifting on this vein was in progress at the time of the writer's visit. In the drift the intersection of the low-dipping vein, which is here dipping at 25 degrees, with the Sylvania vein, occurs. At the intersection the width of the combined veins for a short distance is 2 feet.

At a point on the hillside about 150 feet from the adit previously described, a short adit was started in a northwesterly direction on a vein thought to be the Sylvania. This consists here of a series of stringers which apparently die out along the adit. Connexion between this adit and the drift from the other adit will be made for purposes of ventilation.

The veins were not sampled by the writer. High values have been reported at points, but nothing indicative of a continuous ore shoot has been found. It should, however, be borne in mind that only preliminary development had been done on the property at the time of the writer's visit, and that the amount of drifting on the veins was very small.

Shelly Claims. A group of claims lying southeast of the Vidette holdings is being prospected by W. C. Shelly and associates. Not all of the mineral showings on this ground were seen by the writer. On the Vidette ground close to the border of the Cover claim, which belongs to the Shelly group, there are two shear zones in greenstone about 10 feet apart. In the vicinity of the shear zones the greenstone carries abundant disseminated pyrite, and arsenopyrite has also been reported from this showing but was not seen by the writer. On the Cover claim, near the brow of the hill, an adit has been started on a "vein" striking north 29 degrees east with almost vertical dip. This "vein" is in reality a shear zone with rounded nodules of quartz and calcite in the greenstone, but in the shear zone where traversed by the adit there are one or two stringers of quartz. No sulphide mineralization was seen in the quartz, but the adjacent greenstone carries considerable pyrite.

On the Missing Link claim there is, also near the top of the valley wall, an exposure of augite porphyrite with numerous veinlets exposed in an open-cut about 35 feet long. Most of these veinlets are quite short. A few bulge to form lenses 3 or 4 inches wide and seldom over a foot or two long. Near the northeast side of the cut the mineralization appears to be limited by a wall in the greenstone striking north 55 degrees west and dipping 60 degrees northeast. The greater part of the gangue of these veinlets consists of a flesh-coloured feldspar, with large crystals of calcite, and very little quartz. The ore minerals are chalcopyrite which occurs as fair-sized masses in the veinlets, specular hematite, and a little malachite as an alteration product.

At the top of the valley wall a similar type of deposit occurs with, however, more calcite and less feldspar. The calcite is plentiful along

joints and also replacing the greenstone in veins, seams, and lenses. The calcite veins carry a little of the flesh-coloured feldspar, but no metallic minerals were noted.

On the Grebo claim, which is about opposite the narrows of Vidette lake, a shear zone contains rounded masses of quartz with a maximum width of a foot. The general strike of the zone is south 70 degrees west and the dip about 40 degrees northwest. With the quartz is considerable ankerite, but no evidence of sulphide mineralization.

A group of cuts and a short adit have been driven on a small creek, on a claim the name of which could not be ascertained. On the hill back about 50 yards from the creek an open-cut shows a small seam of quartz in sheared greenstone filled with ankeritic carbonates. Immediately below on the creek a short adit has been driven on a zone somewhat similar to that on the Missing Link claim. This consists of seams of coarsely crystalline calcite and pinkish feldspar, but no chalcopyrite or specularite was seen. The rock along the zone contains abundant disseminated pyrite. A considerable amount of open-cutting has been done along the creek above the adit, on shear zones in the greenstone, but these on the whole exhibit very little quartz.

The Hamilton Creek Mines, Limited, is prospecting a group of claims lying northwest of the workings of Vidette Gold Mines, Limited. A number of trenches have been opened and diamond drilling was started at the bottom of the steep slope on the western side of Hamilton creek.

The most northerly cut shows a quartz vein striking north 80 degrees west and dipping northeast at 60 to 65 degrees. The vein varies rapidly along the strike from a maximum of 10 inches to a mere seam. In a cut immediately south from this are irregular bunches of quartz mineralized with pyrite, chalcopyrite, and a little malachite.

About 50 to 60 feet south a long trench has been run up the hillside and 20 feet from the lower end of the trench a seam of quartz 2 inches wide was encountered. About 150 feet from the lower end of the trench there is a strong vein striking north 60 degrees west and dipping 80 degrees to the northeast. This is about 2 feet wide and is mineralized with calcite and bands of brown ankerite and carries only minor amounts of quartz. A little pyrite occurs in the wall-rock, but none was noted in the vein.

The drilling has shown a number of veins and seams of quartz, mineralized in places with pyrite, but the work had not progressed far enough at the time of the writer's visit to relate the different occurrences. There is a possibility that one or other of these may represent the continuation of the Tenford vein, but in view of the distance from the last known exposure of this vein and the possibility of faulting of the vein, such a conclusion may not be reached without more evidence.

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